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Petrography of Pennsylvanian Underclays in Illinois and Their Application to Some Mineral Industries

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PETROGRAPHY OF PENNSYLVANIAN UNDERCLAYS IN ILLINOIS AND THEIR APPLICATION TO SOME MINERAL INDUSTRIES

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ABSTRACT

The mineralogical and textural properties of underclays from many areas in Illinois and from many stratigraphic positions in the Pennsylvanian System have been studied to determine their possible influence on the stability of the underclays during and after mining of associated coals as well as the usefulness of the underclays for making various types of clay products. Clay mineral composition is the most important property for determining the usage of underclays as well as their stability after mining of associated coals. The underclays studied have clay mineral compositions suited for uses ranging from high heat-duty refractories, high temperature-bonding clays and flue liners to sewer pipe and other red-burning structural clay products. A semiquantitative evaluation of the clay mineral composition and suggested uses, based on ceramic tests run on similar materials, is presented for each sample studied.

Clay mineral variation maps were prepared for the underclays below the Colchester (No. 2), the Harrisburg-Springfield (No. 5), and the Herrin (No. 6) Coal Members to illustrate the regional variations possible in underclay mineralogy, to aid in the exploration for underclay deposits of desired clay mineral compositions, and to show where clay mineral composition may cause problems in mining of coals. The distribution patterns show that kaolinite with some mixed-layer material occurs nearest to shore, that mixed-layer material is dominant in the most basinward positions, and that various ratios of kaolinite, illite, chlorite, and mixed-layer material dominate intermediate environments. The pattern of variation in clay mineral composition and the lack of alteration effects that can be attributed to soil-forming processes appear to be strong evidence that underclays

are transported sediments deposited in aqueous environments. Based on particle-size distribution, most underclays are siltstones.

INTRODUCTION

This report is a compilation of various mineralogical and textural data on underclays, sediments that often occur beneath coals of Pennsylvanian age in Illinois. Data from both published and unpublished geological studies of the authors and others of the Illinois State Geological Survey have been assembled here in order to integrate related information pertaining to the mineral make-up of underclays and to relate this to certain industrial uses and to coal-mine engineering problems.

Underclays have long served as an important source of clay for refractories, structural clay products, bonding material in synthetic molding sands, face brick, and pottery. The uses of a particular underclay are governed principally by the clay minerals present. For example, underclays used to make refractory brick, light-burning face brick, and flue liners must contain a high percentage of kaolinite in relation to other minerals. However, underclays containing illite and/or chlorite may be used for making red-burning clay products such as face brick, flowerpots, and drain tile, but are not suitable for refractories. The mineralogy of an underclay also influences its workability (plasticity), green and dry strengths, and shrinkage during drying and firing. Thus, clay mineralogical data often serve as a guide to the selection of the most suitable industrial use of an underclay.

In addition to ceramic uses, underclays form the floors of most coal mines. The mineralogical and textural characteristics of the underclay may determine the stability of the floor during and following mining operations. For this reason, nuerous samples from cores have been studied to evaluate the characteristics of underclays in areas where mining of overlying coals is now underway or where they may be mined in the future.

Studies of underclays in Illinois have shown (1) that the clay mineral assemblages comprising this sediment often vary regionally in a systematic manner, and (2) that major differences in clay mineral assemblages frequently occur from one stratigraphic unit to another. The recognition of these relationships has been valuable in making recommendations to those persons prospecting for new underclay deposits of a specific nature. A primary purpose of this report is to make this type of information readily available to clay industries.

Most counties in Illinois underlain by Pennsylvanian strata have some underclays of potential economic significance. Those counties that contain underclays for which mineralogical information is included in this report are shown in figure 1, and the location by county of underclays sampled, their clay mineral assemblages, and other available information regarding thickness, stratigraphic position, and source of sample are given in the Appendix. Particle-size distribution of selected underclay samples taken from below the Colchester (No. 2), Harrisburg-Springfield (No. 5), and Herrin (No. 6) Coal Members is found in tables 1, 2, and 3, respectively.

Most underclays were sampled as single units; however, in a few instances, a single underclay was sampled at two, three, or more positions to determine if vertical changes in its clay mineralogy and textural properties were present. These multi-unit samples are assigned the same number, but the uppermost sample is designated as "a," the next lower sample "b," and so forth. An asterisk following a

sample number signifies that ceramic tests have been made on the sample and these either have been published or are on open file at the Illinois State Geological Survey offices (Parham, 1959, 1960, 1961; Parham and White, 1963; White, 1963; White and Lamar, 1960; White and Parham, 1967).

The stratigraphic position within the Pennsylvanian System of each underclay studied, if known, is given in figure 2. The classification used herein is adapted from Kosanke et al. (1960).

PHYSICAL AND MINERALOGICAL CHARACTERISTICS OF UNDERCLAYS

Pennsylvanian underclays are fine-grained, argillaceous, nonbedded, gray-colored, sedimentary rocks normally found directly beneath coals. However, some sandy and silty rocks with plant rootlets are called underclays if they lie below coals. Organic material is usually most abundant in the upper few inches, giving this zone a darker color; however, the total organic content seldom exceeds a few percent. Underclays often contain well developed slickensided surfaces with random orientation and limited extent. Slickensides are usually destroyed by weathering. Root traces of Pennsylvanian age plants, when present, are more abundant in the upper portion. Underclays may be noncalcareous throughout, but many are calcareous below the top few inches. The contact between coal and underclay is usually sharp, whereas the contact of underclay and the sediment below is normally gradational. The sedimentary rock type beneath the underclay is variable.

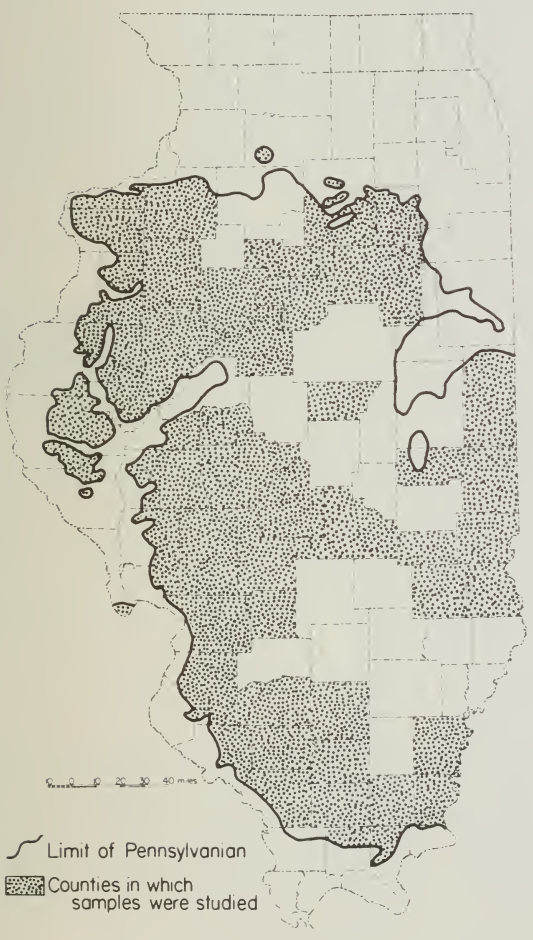


Figure 1 - Limit of Pennsylvanian and counties in which underclays were studied.

Underclays are common in the Pennsylvanian sediments of Illinois and occur in a cyclic pattern with certain other sedimentary rock lithologies (fig. 3). This sedimentary cycle has been named a cyclothem (Wanless and Weller, 1932). Some of the individual lithic units may be missing or poorly developed in a given cyclothem. The underclay, however, is one of the most persistent lithic units in cyclothems of Pennsylvanian age, some having been traced from Pennsylvania to Kansas. They are usually more persistent than the coals normally associated with them. The thinning and pinching out of underlying units may result in

a cyclic sequence in which a single underclay will rest upon varying lithologies (Wanless, 1957).

Underclays vary in thickness from a few inches to over 30 feet, but are usually only a few feet thick. They may change in thickness from inches to 10 or more feet within 10 or 15 yards laterally. Generally, however, they are not this variable. The underclay thickness cannot be related to the thickness of the overlying coal; in fact, underclays several feet thick are known where no superjacent coal is present. In some areas where the other sediments of the cyclothems are absent, these thick underclays may actually be composites representing two or more cyclothems. The underclay of a particular cyclothem may be absent in some areas, and in those cases, the plant root-traces may be preserved in other rock types that lie beneath the coal.

The mineral content of underclays may be conveniently divided into clay minerals and nonclay minerals. The clay minerals occurring in Illinois underclays are commonly kaolinite, illite, chlorite, and random mixed-layer illite-montmorillonite. Montmorillonite, vermiculite, and regular mixed-layer material also are known to occur in some of the underclays, but they are not abundant and, when present, are generally restricted to small areas. Random mixed-layer illite-montmorillonite, having swelling characteristics approaching that of montmorillonite, constitutes a major portion of the clay fraction of underclays in some areas. Most underclays contain two or more of the common clay minerals.

TABLE 1 — PARTICLE SIZE DISTRIBUTION IN SELECTED SAMPLES OF THE UNDERCLAY BELOW THE COLCHESTER (NO. 2) COAL MEMBER IN ILLINOIS

Sample no.	County	Particle size (in percent)			Sample no.	County	Particle size (in percent)		
		Sand	Silt	Clay			Sand	Silt	Clay
991-g	Adams	8	46	47	960-d	Madison	11	66	23
1369	Adams	—	74	36	976-xx	McDonough	5	53	43
1370	Adams	10	51	39	1379	McDonough	4	64	32
1378	Bond	6	77	18	1380	McDonough	—	69	31
990-h	Brown	6	60	34	1395-a	Mercer	34	39	28
1067-b	Calhoun	3	43	56	1395-b	Mercer	26	47	27
1368	Cass	—	63	37	1438	Montgomery	9	65	26
F-199	Fulton	2	50	49	1309-a	Perry	9	60	32
1371	Fulton	2	64	34	1309-b	Perry	5	57	39
1383	Fulton	1	43	57	1309-c	Perry	10	71	20
1392	Fulton	9	70	21	996-m	Pike	10	51	39
1341	Gallatin	20	68	12	1381	Pike	19	52	29
958-f	Greene	1	62	39	1382-a	Pike	14	61	25
958-h	Greene	7	61	32	1382-b	Pike	2	59	39
958-w	Greene	9	48	44	1430	Randolph	5	61	44
1375	Hancock	15	52	33	1390	Rock Island	6	57	36
1389	Henry	8	53	40	1372	St. Clair	6	62	32
J-57	Jackson	4	62	34	1377-a	St. Clair	11	51	38
1320-a	Kankakee	6	71	24	1377-b	St. Clair	5	64	32
1385	Knox	2	75	23	1384	St. Clair	13	67	20
1391	Knox	—	72	29	1435	Saline	2	54	45
1394-a	Knox	4	65	31	978-kkk	Schuyler	6	44	50
10	LaSalle	16	46	38	978-ooo	Schuyler	6	50	45
1387	LaSalle	73	12	14	1374-a	Schuyler	4	58	39
1388	LaSalle	1	71	28	1374-b	Schuyler	13	68	20
1397	LaSalle	35	32	33	977-v	Warren	—	60	40
960-c	Madison	2	55	43	1373	Williamson	3	62	35
					1376	Williamson	10	56	35

The most common nonclay minerals in Illinois underclays include quartz, carbonates, pyrite, siderite, and gypsum. Minor quantities of tourmaline, leucoxene, rutile, garnet, zircon, muscovite, and feldspar also occur in many underclays.

Petrographic Data

Clay Mineral Abundances

Semiquantitative estimations of clay mineral abundances in those underclays studied were determined by X-ray diffraction techniques on oriented aggregates of

TABLE 2 — PARTICLE SIZE DISTRIBUTION
IN SELECTED SAMPLES OF THE UNDERCLAY BELOW
THE HARRISBURG–SPRINGFIELD (NO. 5) COAL MEMBER IN ILLINOIS

Sample no.	County	Particle size (in percent)		
		Sand	Silt	Clay
1290–a	Adams	12	66	22
1290–b	Adams	4	73	23
1291–a	Adams	5	76	19
1289–b	Brown	8	67	25
1287–a	Fulton	12	85	3
1287–b	Fulton	15	65	20
1292–a	Fulton	17	66	18
1292–b	Fulton	5	75	19
1157–g	Gallatin	29	60	11
1262	Gallatin	38	50	12
1295–a	Henry	9	61	20
1179	Jackson	1	87	12
1293	Knox	4	79	18
1294–b	Knox	6	64	31
466	Menard	32	74	4
467	Menard	19	71	10
468	Menard	24	66	10
469	Menard	11	71	18
470	Menard	7	84	9
R–11	Randolph	17	73	10
1101–a	Saline	37	54	9
1101–i	Saline	8	83	9
1101–k	Saline	5	84	11
1288–a	Schuyler	7	84	10
1288–b	Schuyler	5	85	10

the less than 2 micron equivalent spherical diameter (E.S.D.) size fraction. The results (Appendix) are expressed in parts in ten (of diffraction effects) rather than in percentage. This semiquantitative method of expressing composition is preferred because of the variable degree of crystallinity that many of the clays possess. The semiquantitative estimations were made according to procedures described by Odom (1963).

Particle-Size Analyses

Particle-size analyses are presented for several dozen samples from the underclay below the Colchester (No. 2) Coal in the Spoon Formation (Parham, 1958, and table 1), and the underclays below the Harrisburg-Springfield (No. 5) and the Herrin

(No. 6) Coals in the Carbondale Formation (Wahl, 1957, and table 2; Spencer, 1955, and table 3). These analyses were made by the pipette method using sodium polyphosphate as a dispersing agent. The size ranges reported are as follows: sand (2 to 1/16 mm), silt (1/16 to 1/256 mm), and clay (less than 1/256 mm).

Heavy and Light Mineral Composition

Heavy and light minerals were studied from several dozen samples of the underclays below the Colchester (No. 2), Harrisburg-Springfield (No. 5), and Herrin (No. 6) Coals. Standard petrographic techniques were used in the study of the heavy and light minerals, and the potassium and sodic feldspars were differentiated with staining techniques.

TABLE 3 — PARTICLE SIZE DISTRIBUTION IN SELECTED SAMPLES OF THE UNDERCLAY BELOW THE HERRIN (NO. 6) COAL MEMBER IN ILLINOIS

Sample no.	County	Particle size (in percent)		
		Sand	Silt	Clay
1131-a	Christian	7	75	18
2000-a	Christian	18	76	6
2000-b	Christian	20	67	11
1130	Gallatin	8	75	16
1161-a	Jefferson†	9	81	10
1161-b	Jefferson	10	80	10
1161-c	Jefferson	2	84	14
1161-d	Jefferson	3	84	13
1161-e	Jefferson	7	81	12
1161-f	Jefferson	19	70	11
1161-g	Jefferson	6	82	12
1161-h	Jefferson	4	81	14
1161-i	Jefferson	7	80	13
1161-j	Jefferson	17	73	10
1161-k	Jefferson	23	67	10
1161-l	Jefferson	20	69	11
1133	Perry	9	79	13
1134	Perry	5	85	10
1135	Randolph	1	65	33
1136	St. Clair	23	57	19
1137	St. Clair	13	82	5
1129	Williamson	11	80	9

†Sample 1161-a was taken from the top 6 inches; samples 1161-b through 1161-l were taken at 6-inch intervals.

Clay Mineral Composition

X-ray diffraction methods are the best available means presently known for the identification and the evaluation of relative abundance of clay minerals. Only a semiquantitative evaluation of the abundance of individual clay minerals was attempted in this study, because most underclays consist of a mixture of two or more clay minerals of varying degrees of crystallinity, making a strictly quantitative analysis all but impossible. Because a well crystallized clay mineral has a greater diffracting power than a poorly crystallized form of the same mineral, the well crystallized mineral would appear to be more abundant.

The X-ray diffraction traces shown in figure 4 represent the range of clay mineral assemblages found in the underclays studied. The traces are labeled A, B, C, through Q and, generally, are arranged in order of decreasing kaolinite content,

PENNSYLVANIAN SYSTEM*

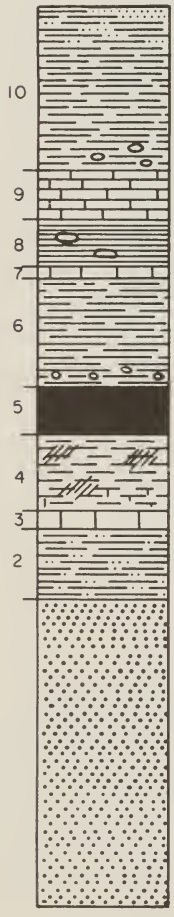
GROUP	FORMATION	MEMBER		
		WESTERN ILLINOIS	SOUTHWESTERN ILLINOIS	SOUTHEASTERN ILLINOIS
MC LEANSBORO	Mattoon			Reisner Limestone Woodbury Limestone Shelbyville Coal
	Bond			
	Modesto	Chapel (No. 8) Coal	New Haven Coal Chapel (No. 8) Coal DeGraff Coal	New Haven Coal Womac Coal Chapel (No. 8) Coal
KEWANEE	Carbondale	Danville (No. 7) Coal Herrin (No. 6) Coal Springfield (No. 5) Coal Summum (No. 4) Coal Lowell Coal Cardiff Coal Colchester (No. 2) Coal	Danville (No. 7) Coal Herrin (No. 6) Coal Briar Hill (No. 5A) Coal Springfield (No. 5) Coal Summum (No. 4) Coal Colchester (No. 2) Coal	Danville (No. 7) Coal Herrin (No. 6) Coal Briar Hill (No. 5A) Coal Harrisburg (No. 5) Coal Summum (No. 4) Coal Colchester (No. 2) Coal
	Spoon	Abingdon Coal Greenbush Coal Wiley Coal Seahorne Limestone DeLong Coal Brush Coal Hermon Coal Rock Island (No. 1) Coal	Murphysboro Coal	Dekoven Coal Davis Coal Wise Ridge Coal Mt. Rorah Coal New Burnside Coal Bidwell Coal
MC CORMICK	Abbott	Tarter Coal		
	Casey-ville			Gentry Coal

*Named units are those associated with underclays studied.

Figure 2 - Stratigraphic position of underclays studied.

although Types O, P, and Q usually contain only small amounts of kaolinite. The diffraction trace from each sample studied was compared with the traces in figure 4 and was assigned the most closely matching letter value, which is recorded in the Appendix under "Type." Because of the factors involved in evaluating the abundance of individual clay minerals previously described, samples with the same type letter or even similar type letters do not consistently have the same clay mineral compositions. The letter values were assigned on the appearance of the total diffraction trace, rather than on the relative abundance of individual clay mineral components. The letter values are used in the preparation of maps showing regional variations in clay mineral assemblages of certain underclay units and in the classification of all underclay samples as to possible use. The general clay mineral composition as represented by the type X-ray curves is as follows:

Type A: Predominantly kaolinite with a small amount of mixed-layer material.



10 Shale, gray, sandy at top; contains marine fossils and ironstone concretions, especially in lower part.

9 Limestone; contains marine fossils.

8 Shale, black, hard, laminated; contains large spheroidal concretions and marine fossils.

7 Limestone; contains marine fossils.

6 Shale, gray; pyritic nodules and ironstone concretions common at base; plant fossils locally common at base; marine fossils rare.

5 Coal; locally contains clay or shale partings.

4 Underclay, mostly medium to light gray except dark gray at top; upper part noncalcareous, lower part calcareous.

3 Limestone, argillaceous; occurs in nodules or discontinuous beds; usually nonfossiliferous.

2 Shale, gray, sandy.

1 Sandstone, fine grained, micaceous, and siltstone, argillaceous; variable from massive to thin bedded; usually with an uneven lower surface.

Figure 3 - An ideally complete cyclothem (reprinted from Willman and Payne, 1943, Illinois Geol. Survey Bull. 66, fig. 42).

Type B: Predominantly kaolinite with a larger amount of mixed-layer material than Type A.

Type C: Predominantly kaolinite with a larger amount of mixed-layer material than Type B.

Type D: Predominantly kaolinite with a moderate amount of mixed-layer material.

Type E: Kaolinite is the major component. Less mixed-layer material and some illite may be present.

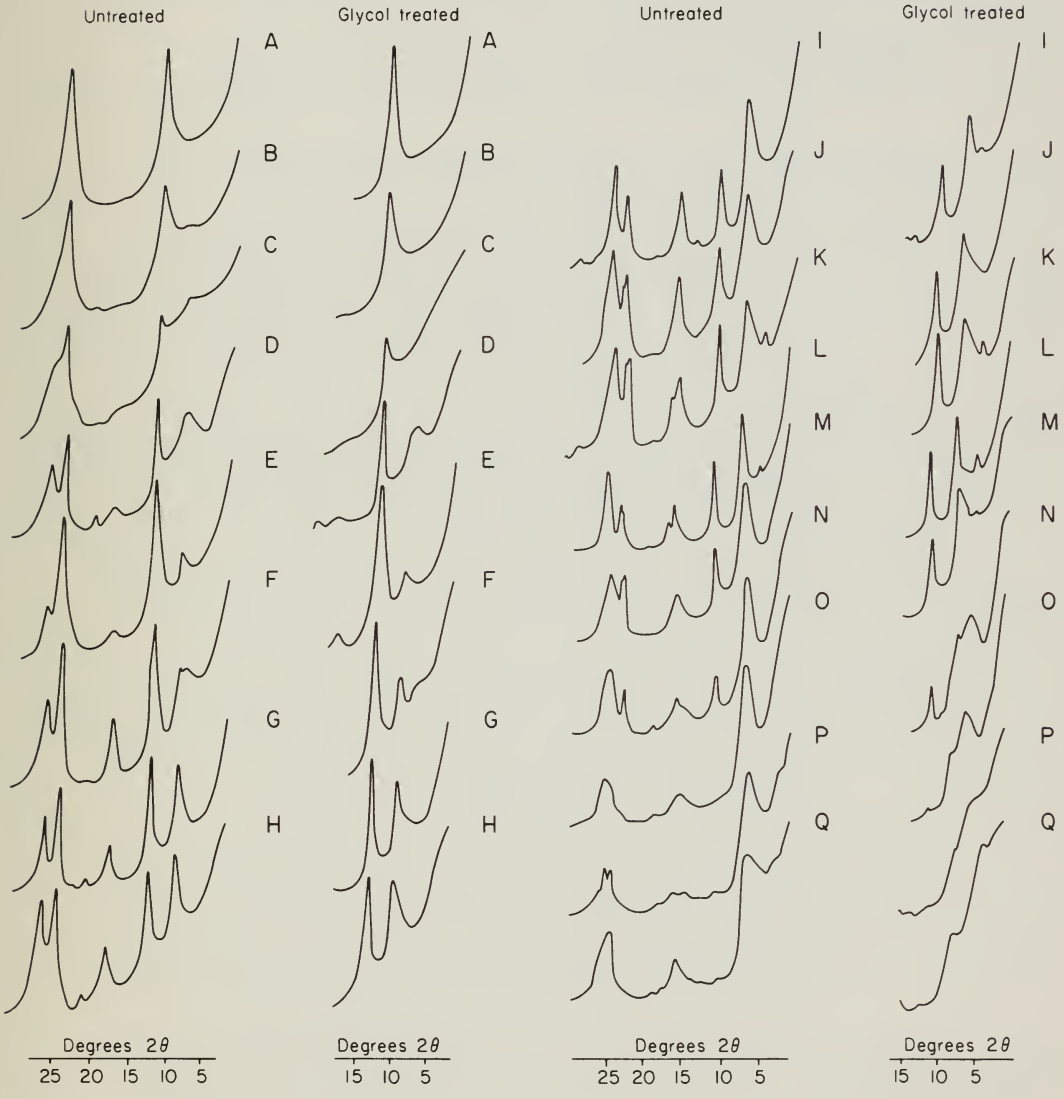


Figure 4 - Type underclay X-ray traces A through Q.

Type F: Kaolinite is dominant and there is a greater amount of illite than in Type E.

Type G: Slightly more kaolinite than illite. Some mixed-layer material is present.

Type H: Kaolinite and illite are approximately equal. Some mixed-layer material is present.

Type I: Illite is dominant and kaolinite is present in lesser amounts.

Type J: Similar to Type I; however, a small amount of chlorite is usually present.

Type K: The abundance of illite remains about the same as in Type J, but chlorite has increased in amount relative to kaolinite.

Type L: This curve is similar to Type K but contains a larger amount of chlorite.

Type M: Chlorite has decreased in relation to kaolinite or is absent. The basal reflections of illite are broad, and ethylene glycol treatment indicates mixed-layer components in the range of 2° to 3° 2θ and/or 7.5° to 8.0° 2θ. The amount of the mixed-layer component may be greater than the amount of illite.

Type N: Chlorite is absent, and the mixed-layer material after ethylene glycol treatment forms broad reflections near 7° and occasionally near 3° 2θ. Some illite is present.

Type O: Three blunt intense reflections are present near the positions of illite's first three basal (00ℓ) X-ray reflections. A moderate amount of mixed-layer material is present, and small quantities of kaolinite may be present.

Type P: This curve is similar to Type O; the mixed-layer component produces X-ray reflections after ethylene glycol treatment at approximately 6.4° 2θ and occasionally between 2° and 3° 2θ. Some illite is present, and a small amount of kaolinite may be present.

Type Q: The mixed-layer component shows broad intensity maxima indicating an illite-montmorillonite mixed system. After glycolation, Type Q develops maxima near 9°, 6°, and 2° to 3° 2θ. A small amount of illite and occasionally a trace of kaolinite are present. Unmixed montmorillonite occasionally present in appreciable quantities.

A few generalizations may be made concerning this sequence of clay mineral assemblages. Starting with the Type A composition of kaolinite and mixed-layer material, kaolinite and the mixed-layer material gradually decrease as illite increases. Chlorite appears first in Type J, persists in some samples to Type M,

and is no longer distinguishable in Type N. Prominent mixed-layer components usually appear at Type M and are predominant in Type Q. The notable difference between the mixed-layer component in Types A – C and Types M – Q is that in the latter the mixed-layer material forms more definable intensity maxima and a small portion tends to expand to a greater degree with ethylene glycol treatment.

Clay Mineral Assemblages

The clay mineral assemblages of many underclay units from various positions in the Pennsylvanian System and from many locations in Illinois are given in the Appendix. The data show that there is a wide variation in the clay mineral content of different underclays within individual counties and regionally in the state, and that in some areas, the mineralogy of individual underclays remains quite consistent, whereas in other areas, the mineralogy of these same underclays shows considerable variation.

A large number of samples of the underclays below the Colchester (No. 2), Harrisburg-Springfield (No. 5), and Herrin (No. 6) Coals was obtained during the course of this investigation because these coals have been or presently are being mined in many parts of Illinois. Study of the clay mineral assemblages showed that in each underclay, the clay mineralogy varied in a regional manner. By plotting the letter value of each sample at its geographic location and then contouring sets of consecutive letters, a mineralogical variation map was prepared for each underclay unit (figs. 5, 6, and 7).

The contours used to subdivide the clay mineral assemblages should not be construed to indicate the high degree of accuracy that they might imply. In some instances, lateral mineralogical changes may be quite abrupt, but in most instances they are gradational over several miles. Changes in the maps are to be expected as more data become available. Information is especially limited in deeper parts of the Illinois Basin because core samples are lacking.

Parham (1964) concluded that regional clay mineralogical variations in underclays are related to depositional processes and to chemical regrading of mixed-layer material in a basinward direction to form illite and chlorite. He felt that the larger particle size of kaolinite causes it to settle nearest to shore. Thus, in general, an increase in kaolinite content in one sample relative to another may be used as a directional property for locating land areas that existed during the underclay deposition. According to this concept, Types A – C, which consist mainly of kaolinite, would have been deposited in near-shore areas, while Types P – Q, representing only highly disordered nonregradable weathered material, would have been deposited in the most basinward areas.

The mineralogical maps are intended to serve as a guide in exploring for underclays with certain desired clay mineral compositions and to provide information on underclay mineralogy in regions where the clay composition might cause floor or roof problems in underground coal mining operations. As additional samples become available, the clay mineralogy will be checked.

Most other underclays studied show clay mineralogical variations similar to underclays below the Colchester (No. 2), Harrisburg-Springfield (No. 5), and Herrin (No. 6) Coals, but at this time, analyses are not sufficient to permit the preparation of maps illustrating these variations.

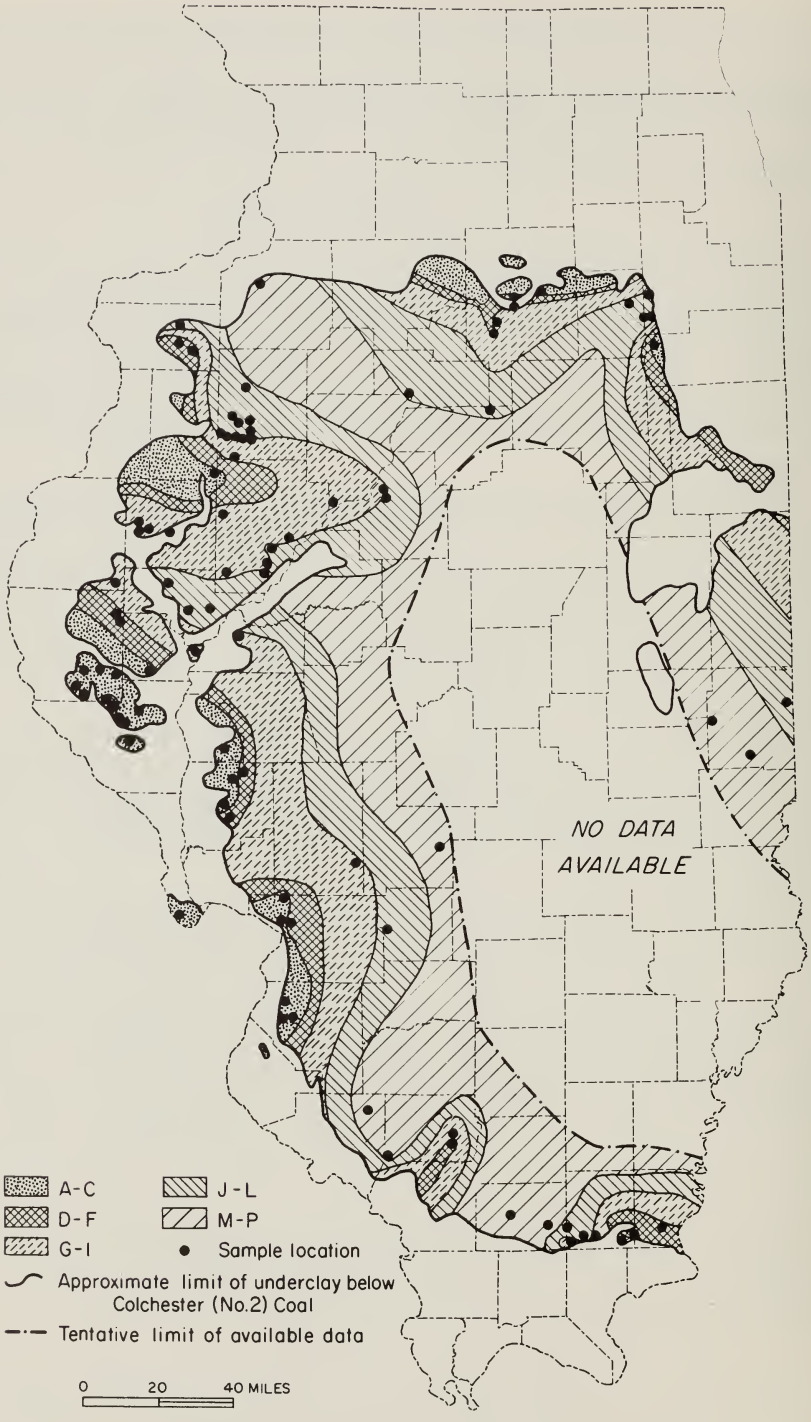


Figure 5 - Generalized distribution of similar clay mineral assemblages in underclay below Colchester (No. 2) Coal.

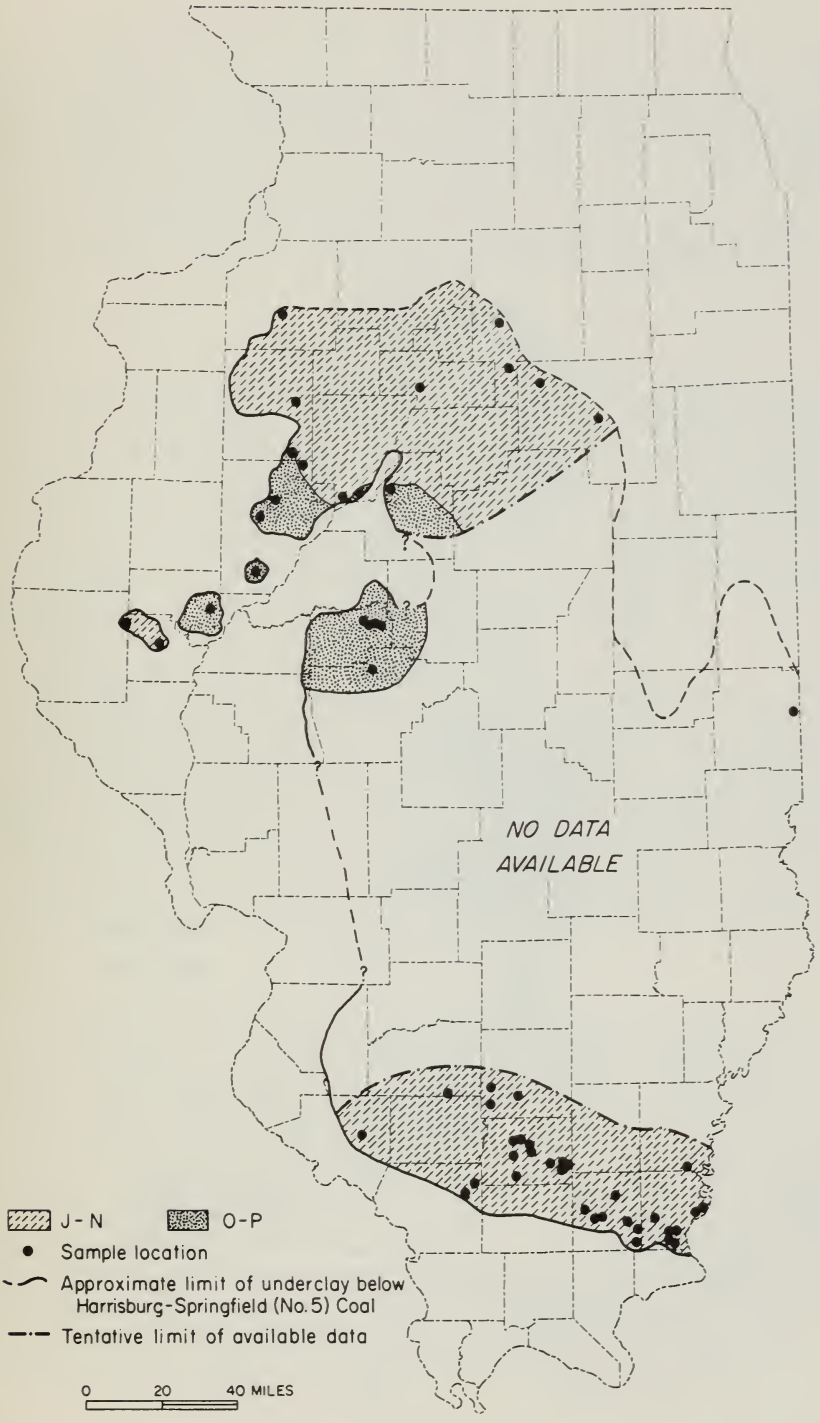


Figure 6 - Generalized distribution of similar clay mineral assemblages in underclay of Harrisburg-Springfield (No. 5) Coal.

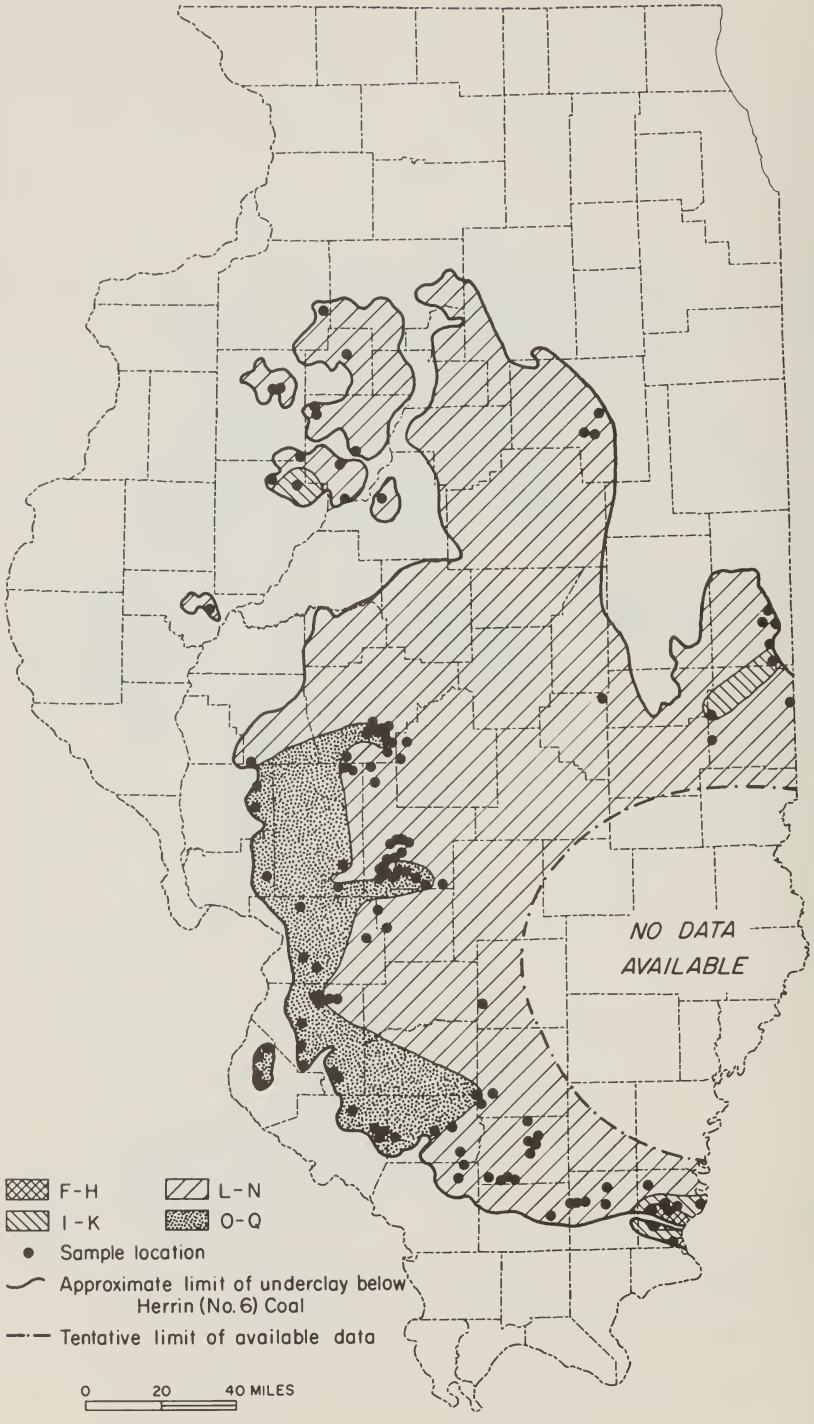


Figure 7 - Generalized distribution of similar clay mineral assemblages in underclay below Herrin (No. 6) Coal.

Heavy Minerals

Heavy minerals studies have been made on 52 samples of the underclay below the Colchester (No. 2) Coal (Parham, 1958), on 31 samples of the underclay below the Harrisburg-Springfield (No. 5) Coal (Wahl, 1957), and on 30 samples of the underclay below the Herrin (No. 6) Coal (Spencer, 1955). Light mineral identifications were also made by Wahl and Spencer.

The heavy mineral assemblages in all three underclays are very similar, for the most part, and consist mainly of pyrite, zircon, tourmaline, leucoxene, and rutile.

Pyrite

Pyrite is by far the most common heavy mineral in all three underclays, and it occurs in a wide variety of forms—striated cubes, octahedrons, pyritohedrons, spherulites, irregular masses, and as replacements of tiny rootlets and fine plant structures. Pyrite in the underclay of the No. 2 Coal is more abundant where the underclay has a finer particle size. Pyrite is more abundant in the underclay of the No. 6 Coal near the coal-clay contact. Commonly, in weathered underclay outcrops, pyrite has been altered to limonite. Most of the pyrite is of authigenic origin.

Zircon

Zircon is also common in these underclays and normally occurs in two general forms. The first is as colorless, subhedral to euhedral, prismatic, pyramid-terminated crystals that may contain small isotropic spherical or elipsoidal inclusions. The second type occurs as well rounded grains. The well rounded zircons in the underclay of the No. 6 Coal are generally pink. Zoning is well displayed in a few of the euhedral crystals in the underclay of the No. 2 Coal, and in a few of the more rounded pink varieties in the underclay of the No. 6 Coal. Crystal morphology suggests that both authigenic and detrital zircon occur in these underclays.

Tourmaline

Tourmaline is a common heavy mineral found in the underclays of the No. 2, No. 5, and No. 6 Coals. It occurs as euhedral crystals, irregular fragments, well rounded grains, and overgrowths on other well worn or fragmental tourmaline grains. The color of the tourmaline of the underclay of the No. 2 Coal varies from colorless through pink, tan, brown, and olive-drab. The color of the underclay of the No. 5 Coal varies from colorless to light brown, and that of the underclay of the No. 6 Coal from green-brown through blue, blue-black, to greenish blue. The euhedral crystals in the underclays of the No. 2 and No. 5 Coals are very light in color, whereas those of the underclay of the No. 6 Coal are mainly green-brown. Inclusions are common in most types of tourmaline found in these underclays. Spencer (1955) and Parham (1958) concluded that the euhedral crystals and overgrowths on rounded grains indicated that some of the tourmaline is authigenic.

Leucoxene

Leucoxene is present in at least a quarter to a half of the samples studied. It appears as rounded, oblong, opaque grains of a dull white to yellow color.

Rutile

Rutile has been identified only in the underclays of the No. 2 and No. 6 Coals. It is normally of a rusty red color but also appears in shades of orange and yellow. Generally, it is detrital in the underclay of the No. 2 Coal. A small number of grains display elbow twinning. The rutile in the underclay of the No. 6 Coal usually appears elongate and shows all degrees of abrasion. Rutile elbow twins are also found in this underclay.

Garnet

Garnet is almost entirely restricted to the underclay of the No. 5 Coal. It was identified only in one sample of the underclay of the No. 6 Coal and was not seen in any samples of the underclay of the No. 2 Coal. Most garnets in the underclay of the No. 5 Coal are colorless; however, a few are pink or red. Most samples in which garnet occurs are limited to the southern Illinois area.

Light Minerals

The light minerals of only the underclays of the Harrisburg-Springfield (No. 5) and Herrin (No. 6) Coals have been studied, and quartz is common to both. Only angular fragments were noted in the underclay of the No. 5 Coal, whereas angular and rounded grains were found in the underclay of the No. 6 Coal. Quartz having undulatory extinction and quartz with a sharp extinction are present in both clays.

Feldspars

Both potassium and sodic plagioclase feldspars are present in the No. 2, No. 5, and No. 6 Coal underclays and are found in all stages of alteration. Oligoclase was the most sodic feldspar noted in the underclay of No. 6 Coal. No consistent order in the vertical position of the most or least altered feldspars was noted in either underclay.

Siderite

Siderite was found only in the underclay of the No. 6 Coal in the area of Edgar County in eastern Illinois.

Minor amounts of muscovite are present in all three underclays. Detrital chlorite was identified in a few samples, and hypersthene was found in one sample of underclay of the No. 6 Coal.

Particle Size

Particle-size analyses were made on 64 samples of the underclay below the Colchester (No. 2) Coal (Parham, 1958), on 29 samples of the underclay below the Harrisburg-Springfield (No. 5) Coal (Wahl, 1957), and on 20 samples of the underclay below the Herrin (No. 6) Coal (Spencer, 1955). The median grain size values for these underclays indicate that most of them are actually silts (tables 1, 2, and 3).

Parham's findings for the underclay below the No. 2 Coal indicated that the median grain size increased from west to east in Illinois, but no consistent

variation in the particle size was noticeable in a north-south direction. His results further showed that the median grain size was largest where the subjacent sediment was sandstone, decreasing in the order of siltstone, shale, limestone, and underclay. Wahl (1957) found that the median grain size of the underclay below the No. 5 Coal increased from northern and north-central Illinois to the southeastern part of the state.

Sorting coefficients indicate that the underclays studied are well sorted sediments.

SUGGESTED USES OF UNDERCLAYS

The type and quantity of clay minerals composing a clay-rich sediment has a pronounced influence on the sediment' s physical properties, and these, in turn, govern its industrial use. Refractoriness, for example, is largely controlled by the quantity of kaolinite present in the clay in relation to other minerals—the more kaolinite, the greater the refractoriness. The color is controlled by the mineralogy. Red-colored structural clay products can be made from clay materials containing illite, chlorite, and/or mixed-lattice clays. White- and buff-colored products can be made from clays containing appreciable quantities of kaolinite.

The potential uses of many of the underclays studied have been evaluated through ceramic and other standard testing procedures, and the results of these tests, in turn, have been correlated with clay mineral composition. The following are suggested uses for the underclays studied, based on their clay mineral composition (Appendix):

Suggested use	Clay mineral composition	
Bonding clays: High temperature	A – C	
Low temperature	N – Q	
Drain tile	A – Q	
Fillers: Color important	A – C	
Color not important	A – Q	
Flower pots	A – Q	
Flue liners	A – E	
Lightweight aggregate	M – Q	
Pottery	A – Q	
Refractories and refractory cements:		
High heat-duty	A – B	Note: (Heat duty estimated from clay mineralogy and Pyrometric Cone Equivalents (P.C.E.) values for selected samples)
Medium heat-duty	C – D	
Low heat-duty	E – H	
Sewer pipe	A – Q	
Stone ware	A – G	
Structural clay products:		
Light colored	A – G	
Brown to red colored	H – Q	
Terra cotta	A – E	
Terra Sigillata	A – C	

The reader is reminded that plastic properties, total shrinkage, and color of fired clay products depend on the total mineralogy of the clay material used. Because the clay mineral and nonclay mineral compositions of underclays may vary substantially from one underclay to the other, above or below and regionally within a single underclay member, it is recommended that potential underclay deposits be thoroughly sampled and tested before mining is considered. Consideration also should be given to the possibility of blending two or more underclay types to obtain the physical properties desired.

RELATION OF CLAY MINERALOGY TO SOME UNDERCLAY SQUEEZES

The plastic flow of underclay after removal of coal has been known to occur in underground mines in several regions of the state. The movement of underclay into mined-out spaces produces structural weakness in pillars and walls and may lead to collapse of the coal mine roof rock. White (1956) concluded that squeezes that occurred in a coal mine in southwestern Illinois were related to the presence of swelling mixed-layer and montmorillonite clay minerals in the underclay, overburden pressure, and excess moisture in the underclay. Clay mineral analyses of underclays involved in several squeezes in Illinois mines show that they are similar in composition to Types P and Q (fig. 4).

A large area of P and Q type underclays occurs below the No. 6 Coal in south-central and southwestern Illinois (fig. 7). Only one sample of Type P or Q underclay to date has been found in the underclay below the No. 5 Coal in northeastern Adams County. No Type P or Q underclays have been found below the No. 2 Coal, but relatively few samples have been analyzed from near the central part of the Illinois Basin.

The occurrence of underclays with Type P or Q clay mineral compositions should not be considered a deterrent to the mining of the overlying coals. However, it is recommended that sufficient testing of the underclay should always be included in mine planning to permit appraisal of the clay mineralogy and its potential effect on coal mining problems.

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APPENDIX

APPENDIX

UNDERCLAYS SAMPLED IN STUDY

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
ADAMS COUNTY																	
991-g*	NE	SW	NE	18	2S	5W	10	—	—	<1	—	—	24"	No. 2 Coal	A	oc	X
1290-a		NE	NW	24	1N	5W	—	4	—	6	—	—	6"	No. 5 Coal	O	oc	
1290-b		NE	NW	24	1N	5W	—	4	—	6	—	—	14"	No. 5 Coal	O	oc	
1291-a		SW	NE	13	1N	5W	—	5	—	6	—	—	3"	No. 5 Coal	O	oc	
1369	SE	SE	SE	12	2N	5W	7	2	—	1	—	—	8"+	No. 2 Coal	F	mi	X
1370	SW	SW	SW	24	2N	5W	8	—	—	2	—	—	33"	No. 2 Coal	D	oc	X
1663	SW	SE	SE	29	2S	6W	8	—	—	2	—	—	17"	No. 2 Coal	C	oc	
1787	SE	SE	NE	28	3S	6W	8	—	—	3	—	—	29"+	No. 2 Coal	C	oc	
1788	NE	NW	NW	34	3S	5W	1	5	—	3	—	—	27"	Spoon Fm.	N	oc	
1789	SW	SW	SW	25	3S	6W	4	5	Tr	2	—	—	30"+	Spoon Fm.	J	oc	
1792	NW	NW	NW	18	3S	6W	9	—	—	1	Tr	—	18"+	No. 2 Coal	B	oc	
BOND COUNTY																	
1378	NE	SW	NW	20	5N	4W	3	6	Tr	2	—	—	12"+	No. 2 Coal	J	co	X
1889	SW	SW	NW	18	5N	4W	2	4	—	5	—	—	48"	No. 6 Coal	N	co	
BROWN COUNTY																	
990-h*	SE	SE	NW	29	1S	1W	7	2	—	1	—	—	60"	No. 2 Coal	G	oc	X
1112	SW	SW	SE	8	1S	3W	7	1	—	2	—	—	84"	No. 4 Coal	F	oc	
1289-b		SE	NE	8	1S	3W	1	4	—	5	—	—	24"	No. 5 Coal	N	oc	
1720	NE	NW	SW	18	2S	3W	9	—	—	2	—	—		No. 2 Coal	C	oc	
BUREAU COUNTY																	
A-65				27	17N	11E	1	5	—	4	—	—		No. 6 Coal	N	mi	
CALHOUN COUNTY																	
1067-b*	SE	SW	NE	26	13S	2W	8	—	—	2	—	—	36"	No. 2 Coal	C	oc	X
CASS COUNTY																	
1368	SW	NE	NE	15	18N	11W	5	4	—	1	—	—	24"	No. 2 Coal	H	oc	X
CHRISTIAN COUNTY																	
1131-a	NE	NW	NW	14	13N	4W	1	3	—	6	—	—		No. 6 Coal	N	co	
2000-a		SE	SE	34	14N	2W	2	5	Tr	3	—	—		No. 6 Coal	L	co	X
2000-b		SE	SE	34	14N	2W	2	5	Tr	3	—	—		No. 6 Coal	L	co	X
CLARK COUNTY																	
1864	NE	NE	NW	21	10N	12W	—	9	Tr	<1	—	—	42"+	Modesto Fm.	L	oc	
1865	NW	SE	SE	3	9N	14W	<1	—	—	9	—	—	60"	No. 8 Coal?	O	oc	
1867	SW	NE	NW	29	11N	10W	1	6	2	1	—	—	54"	Modesto Fm.	L	oc	
1868	SE	NW	SE	3	9N	14W	3	5	—	2	—	—	72"	No. 8 Coal?	I	oc	
CRAWFORD COUNTY																	
2063			SW	20	6N	10W	5	2	—	3	—	—	10"	Womac Coal	F	oc	
CUMBERLAND COUNTY																	
1646	SE	SW	SE	32	9N	8E	2	5	3	1	—	—	18"	Coal below Woodbury Ls.	L	oc	
DE WITT COUNTY																	
2095	SW	NW	SE	35	21N	4E	<1	2	—	6	—	—	36"	Abbott Fm.	N	co	
DOUGLAS COUNTY																	
1301-b-c			NW	8	15N	14W	5	3	—	2	—	—	24"	Carbondale Fm.	F	oc	
EDGAR COUNTY																	
1104	SW	SW	SE	32	16N	12W	1	4	2	4	—	—	17"	No. 4 Coal	L	co	
1866	NE	SW	NE	29	14N	10W	8	—	—	2	—	—	10"	No. 8 Coal?	B	oc	

APPENDIX — Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
EDGAR COUNTY (cont.)																	
1870	NE	SW	NW	32	15N	10W	8	—	—	2	—	—	60"	No. 8 Coal?	A	oc	
1873	SW	SW	SE	7	12N	10W	5	2	—	3	—	—	30"	Coal III (Ind.)	H	oc	
1876*	NW	SW	SW	4	14N	10W	7	—	—	3	—	—	36"	No. 8 Coal?	C	oc	
1894	NW	NW	NE	17	12N	10W	3	3	—	4	—	—	24"	Coal III (Ind.)	H	oc	
1981	SE	NW	SE	30	14N	10W	1	4	—	5	—	—	60"	Womac Coal	O	oc	
1982	NW	SE	SW	29	14N	10W	2	2	—	6	—	—	42"	Modesto Fm.	N	oc	
1985	SW	NE	SW	2	14N	11W	2	2	—	6	—	—	2"+	Modesto Fm.	N	oc	
1986	NW	SE	NE	2	14N	11W	2	2	—	6	—	—	48"	Womac Coal	N	oc	
1987	NE	SW	NE	2	14N	11W	1	4	—	5	—	—	36"	Modesto Fm.	N	oc	
2235		SW	NW	20	15N	10W	1	2	2	4	—	—	60"	No. 6 Coal	M	co	
2236		NW	NE	2	12N	12W	1	7	—	2	—	—		No. 2 Coal	N	co	
2242		SW	NW	20	15N	10W	3	2	—	4	—	—	24"	No. 5 Coal	N	co	
2243		SW	SW	10	14N	14W	2	4	2	2	—	—	36"+	No. 2 Coal	M	co	
2248		SW	SW	10	14N	14W	1	4	—	5	—	—	36"+	No. 6 Coal	I	co	
2254		SW	NW	20	15N	10W	1	3	2	4	—	—	10"	No. 2 Coal	K	co	
FAYETTE COUNTY																	
2231		NW	NW	25	8N	3E	2	7	—	2	—	—	12"	Mattoon Fm. (lower)	I	oc	
FRANKLIN COUNTY																	
A-258				28	7S	1E	1	5	—	4	—	—		No. 6 Coal	N	mi	
A-272				33	7S	2E	3	5	—	3	—	—		No. 6 Coal	N	mi	
A-278				33	7S	2E	2	3	—	5	—	—		No. 6 Coal	N	mi	
A-348				35	7S	2E	1	6	—	3	—	—		No. 6 Coal	N	mi	
A-353				35	7S	2E	<1	7	—	2	—	—		No. 6 Coal	N	mi	
1302	SE	SW	NE	24	7N	3E	2	4	2	1	—	—	22"	No. 5A Coal	K	co	
1992	NE	SW	SE	7	6S	3E	1	6	—	3	—	—		No. 6 Coal	N	co	
1993	NE	SW	SE	7	6S	3E	2	4	Tr	5	—	—	24"+	No. 5 Coal	N	co	
1994	NE	NE	SE	15	6S	2E	1	5	—	4	—	—	18"	No. 6 Coal	N	co	
1995	NE	NE	SE	15	6S	2E	1	5	Tr	4	—	—	24"	No. 5 Coal	N	co	
1996	SW	NE	NE	35	5S	2E	3	4	Tr	3	Tr	—	6"+	No. 6 Coal	L	co	
1997	SW	NE	NE	35	5S	2E	1	3	2	4	—	—	12"+	No. 5 Coal	L	co	
1998	SW	NW	NW	5	6S	3E	2	3	Tr	5	—	—		No. 6 Coal	M	co	
1999	SW	NW	NW	5	6S	3E	2	3	2	3	—	—	24"+	No. 5 Coal	L	co	
2020		NW	NE	33	5S	2E	1	5	—	5	—	—		No. 6 Coal	N	co	
2021		NW	NE	33	5S	2E	Tr	8	—	2	—	—	17"+	No. 5 Coal	M	co	
2234			NW	25	7S	2E	1	3	1	5	—	—	24"+	No. 5 Coal	L	co	
2290		NE	NW	27	6S	3E	1	2	—	7	—	—	51"	No. 6 Coal	M	co	
2310	NW	NW	SE	28	6S	3E	<1	4	1	4	—	—	24"	No. 7 Coal	L	co	
2338	SE	NE	NE	4	7S	4E	1	4	2	3	—	—	120"	No. 5 Coal	L	co	
2342	SW	SE	NW	12	7S	4E	1	3	1	5	—	—	42"	No. 5 Coal	L	co	
2345	SE	SE	SW	1	7S	4E	1	3	2	5	—	—	39"	No. 5 Coal	M	co	
2347	SE	SE	SE	1	7S	4E	2	4	2	3	—	—	36"	No. 5 Coal	L	co	
2349	SW	SE	NW	10	7S	4E	1	4	3	1	—	—	36"	No. 5 Coal	L	co	
FULTON COUNTY																	
A-127				3	8N	4E	—	6	—	4	—	—		No. 5 Coal	M	mi	
A-132				3	8N	4E	—	8	—	2	—	—		No. 5 Coal	M	mi	
F-199			NW	33	5N	3E	4	5	—	<1	—	—	24"	No. 2 Coal	J	oc	X
1107			NE	15	3N	2E	1	3	—	6	—	—	45"	No. 4 Coal	M	oc	
1108		NE	NW	21	6N	4E	—	4	—	6	—	—	48"	No. 4 Coal	N	oc	
1287-a	NE	SE	NW	3	3N	2E	—	5	—	6	—	—		No. 5 Coal	O	oc	

APPENDIX – Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
FULTON COUNTY (cont.)																	
1287-b	NE	SE	NW	3	3N	2E	–	7	–	3	–	–		No. 5 Coal	O	oc	
1292-a		NW	SW	36	7N	5E	<1	4	–	6	–	–		No. 5 Coal	O	oc	
1292-b		NW	SW	36	7N	5E	1	5	–	3	–	–		No. 5 Coal	N	oc	
1371		SW	SE	16	6N	1E	5	5	–	<1	–	–	36"	No. 2 Coal	H	oc	X
1383	SE	NW	SE	5	3N	3E	1	3	1	5	–	–	54"	No. 2 Coal	K	oc	X
1392			NE	20	5N	4E	4	5	–	<1	–	–	20"	No. 2 Coal	H	oc	X
1664				32	4N	3E	4	4	–	2	–	–		No. 2 Coal	H	oc	
1843		SE	SE	3	7N	4E	1	4	2	3	–	–		No. 6 Coal	K	mi	
2025-a-b-c		SW	NW	3	3N	1E	5	3	Tr	2	–	–		No. 2 Coal	G	mi	
2092				26	9N	4E	Tr	4	–	6	–	–	20'	No. 2 Coal	M	mi	
2216		NE	NW	21	6N	3E	–	2	–	8	–	–	48"	No. 5 Coal	N	oc	
2218		SW	SW	21	7N	3E	Tr	3	–	7	–	–	24"+	No. 5 Coal	O	oc	
2228		NW	SW	27	8N	3E	1	3	2	4	–	–	30"+	No. 6 Coal	L	oc	
GALLATIN COUNTY																	
A-331				16	9S	8E	1	5	–	3	–	–		No. 5 Coal	N	mi	
A-336				16	9S	8E	1	5	–	4	–	–		No. 5 Coal	N	mi	
1130	SE	SE	SW	10	9S	9E	3	3	–	5	–	–		No. 6 Coal	H	co	
1143	NE	SW	SW	12	9S	8E	6	2	–	2	–	–		No. 6 Coal	F	co	
1157-a	NE	SE	SW	22	10S	9E	1	5	–	4	–	–		No. 6 Coal	N	co	
1157-g	NE	SW	NE	27	10S	9E	–	5	–	5	–	–		No. 5 Coal	N	co	
1262					10S	9W	2	6	–	2	–	–		No. 5 Coal	M	co	
1341	NW	NW	SE	9	10S	9E	8	2	–	<1	–	–	60"	No. 2 Coal	D	co	X
1306-a	NW	SW	SW	14	9S	9E	3	5	Tr	2	–	–		No. 6 Coal	I	co	
1528					10S	9E	9	1	–	<1	–	–	28"+	No. 2 Coal	B	co	
1576		Cen.	SE	9	8S	8E	1	3	–	6	–	–		No. 6 Coal	N	co	
1809*	NE	NW	NE	19	10S	8E	6	2	–	2	–	–	60"	No. 2 Coal	E	oc	
1810*	SW	NE	NE	19	10S	8E	5	3	–	3	–	–	24"	Dekoven Coal	H	oc	
1846	NW	NE	SE	28	10S	9E	4	6	–	<1	–	–		Wise Ridge Coal	H	co	
1884		NW	NE	9	10S	8E	6	2	–	2	–	–		No. 6 Coal	F	co	
2232	NE	NE	NE	11	9S	10E	3	3	–	4	–	–	30"	No. 6 Coal	I	co	
2233	NE	NE	NE	11	9S	10E	2	4	2	2	–	–		No. 5 Coal	L	co	
2268			NE	9	10S	9E	<1	5	–	5	–	–		No. 5 Coal	M	co	
2271	SW	NW	SE	7	10S	9E	1	3	–	6	–	–		No. 5 Coal	M	co	
2272			SE	17	10S	9E	Tr	3	–	6	–	–		No. 5 Coal	M	co	
2276		Cen.	E½	16	10S	9E	<1	6	–	4	–	–		No. 5 Coal	M	co	
2278			SW	4	10S	9E	1	5	–	4	–	–		No. 5 Coal	M	co	
2280	Cen.	W line		9	10S	9E	<1	5	–	4	–	–		No. 5 Coal	M	co	
2281		NW	NW	15	10S	9E	Tr	3	–	6	–	–		No. 5 Coal	M	co	
GREENE COUNTY																	
958-f*	NW	NW	NW	25	12N	11W	7	–	–	3	–	–		No. 2 Coal	D	oc	X
958-h*	NW	SW	SW	28	12N	11W	9	–	–	1	Tr	–	48"	No. 2 Coal	C	oc	X
958-w*	NW	NW	NW	12	10N	12W	9	–	–	1	–	–	30"	No. 2 Coal	B	oc	
1891		NE	SE	18	12N	10W	5	1	–	4	–	–	36"	No. 2 Coal	D	oc	
2217	NE	SW	NE	4	11N	10W	Tr	2	–	8	–	–	30"	No. 6 Coal	P	oc	
2221	SW	NW	NE	30	11N	10W	<1	4	–	6	–	–		No. 6 Coal	P	oc	
GRUNDY COUNTY																	
NF-399	SW	SW	NW	16	33N	8E	1	6	2	1	–	–	30"	No. 2 Coal	K	oc	
1892			Cen.	1	31N	8E	4	–	–	6	–	–		No. 7 Coal	H	co	
1967				36	32N	8E	1	4	2	3	–	–		Cardiff Coal	L	mi	

APPENDIX – Continued

Sample	Location						Clay mineral composition† (parts in ten)						Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
	¼	¼	¼	Sec.	T.	R.	K	I	C	Mx	V	Mt					
GRUNDY COUNTY (cont.)																	
1968	SW	SE	NE	36	33N	7E	5	4	—	1	—	—	24"	?	G	oc	
HANCOCK COUNTY																	
1375		SW	SW	26	3N	5W	5	4	—	1	—	—	42"	No. 2 Coal	H	oc	X
HENRY COUNTY																	
A-73				10	15N	5E	1	6	1	1	—	—		No. 6 Coal	M	mi	
1295-a		NW	SE	9	15N	3W	Tr	6	2	3	—	—		No. 5 Coal	L	oc	
1389			W½	34	17N	2E	2	5	—	2	—	—	30"+	No. 2 Coal	M	oc	X
1611*	NE	NW	SW	19	17N	1E	4	5	1	1	—	—	78"	No. 1 Coal	J	oc	
1676*	SE	SW	SE	30	17N	1E	3	3	Tr	4	—	—	16"	Spoon Fm. (middle)	I	oc	
1677*	SE	SW	SE	30	17N	1E	2	4	Tr	2	—	—	26"	Spoon Fm. (middle)	M	oc	
1678*	SE	SW	SE	30	17N	1E	5	4	—	1	—	—	27"	Spoon Fm. (middle)	H	oc	
1683*	SW	NE	NE	33	14N	1E	5	4	Tr	1	—	—		No. 1 Coal	G	mi	
1690*	NW	SE	SE	21	17N	1E	5	3	—	3	—	—	36"	Spoon Fm. (lower)	G	oc	
1691*	NE	SE	NW	21	17N	1E	5	1	—	4	Tr	—	40"	Spoon Fm. (lower)	F	oc	
1693*	NE	NE	NW	28	17N	2E	7	2	—	1	—	—	42"+	Spoon Fm. (middle)	E	oc	
1694*	NW	NW	NE	28	17N	2E	2	4	—	4	—	—	66"	Spoon Fm. (middle)	I	oc	
1695*	NE	NW	NW	28	17N	2E	4	5	—	2	—	—	72"	Spoon Fm. (lower)	H	oc	
1696*	SW	NW	SW	34	17N	2E	6	2	—	2	—	—	60"+	Spoon Fm. (middle)	F	oc	
1697*	NE	SE	NW	21	17N	1E	6	3	—	2	Tr	—	36"	Spoon Fm. (middle)	G	oc	
1698*	SE	NE	SW	27	17N	1E	6	3	Tr	Tr	—	—	30"+	Spoon Fm.	G	oc	
1699*	NE	NE	NW	22	17N	1E	5	4	—	<1	—	—	30"	Abbott Fm. (upper)	H	oc	
1700*	NE	SW	SW	15	18N	3E	7	2	—	2	Tr	—	42"	Spoon Fm. (lower)	F	oc	
1701*	NE	SW	SW	15	18N	3E	6	3	Tr	1	—	—	44"	Spoon Fm. (lower)	F	oc	
1702*	SE	NW	SW	15	18N	3E	6	3	Tr	1	—	—	48"+	Spoon Fm. (lower)	G	oc	
1703*	NW	NE	SE	24	18N	2E	5	3	—	2	—	—	30"+	No. 1 Coal	H	oc	
1704*	SE	NW	NE	23	17N	1E	5	3	—	2	—	—	36"	Spoon Fm. (middle)	G	oc	
1705*	NW	SW	SE	30	17N	1E	3	6	—	2	—	—	48"	Spoon Fm. (middle)	I	oc	
JACKSON COUNTY																	
A-227				5	7S	1W	<1	4	Tr	5	—	—		No. 6 Coal	N	mi	
A-236				5	7S	1W	1	4	2	3	—	—		No. 6 Coal	L	mi	
A-244				18	7S	1W	1	4	—	5	—	—		No. 6 Coal	N	mi	
A-252				18	7S	1W	1	3	—	6	—	—		No. 6 Coal	N	mi	
J-57				9	7S	4W	5	4	—	1	—	—		No. 2 Coal	H	oc	X
1179	SW	NW	NE	35	7S	2W	1	5	—	4	—	—		No. 5 Coal	N	mi	
1800*	SW	SW	NE	9	9S	2W	4	4	—	1	—	—	36"	Murphysboro Coal	H	oc	
1801*	SE	NE	SW	36	9S	1W	6	3	—	<1	—	—	36"	Murphysboro Coal	F	oc	
1822		Cen.	S½	36	7S	4W	5	3	Tr	2	—	—	18"	Murphysboro Coal	H	oc	

APPENDIX – Continued

Sample	Location						Clay mineral composition† (parts in ten)						Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡	
	¼	¼	¼	Sec.	T.	R.	K	I	C	Mx	V	Mt						
JACKSON COUNTY (cont.)																		
1823	SE	NW	NE	9	7S	4W	2	3	—	6	—	—	12"	Spoon Fm.	N	oc		
1824	SE	NE	SW	36	9S	1W	3	4	—	4	—	—	36"	Murphysboro Coal	I	oc		
1827	NE	NE	SE	9	7S	4W	2	3	—	5	—	—	16"+	Spoon Fm.	N	oc		
1828	SE	NE	SW	4	7S	4W	2	2	—	6	—	—	36"+	No. 2 Coal	N	oc		
2091				16	8S	1W	1	6	—	3	—	—	48"+	No. 5 Coal	N	mi		
JASPER COUNTY																		
2045	NE	NE	NE	2	7N	9E	1	4	2	3	—	—	48"	Coal below Reisner Ls.	N	oc		
2055	NE	SW	SW	15	7N	10E	<1	7	—	2	Tr	—	60"	Mattoon Fm.	P	oc		
JEFFERSON COUNTY																		
1161-a	SW	SE	NW	16	4S	1E	1	4	2	3	—	—	6"	No. 6 Coal	L	co		
1161-b	SW	SE	NW	16	4S	1E	1	3	1	4	—	—		No. 6 Coal	L	co		
1161-c	SW	SE	NW	16	4S	1E	1	4	1	4	—	—	6"	No. 6 Coal	L	co		
1161-d	SW	SE	NW	16	4S	1E	<1	3	1	5	—	—	6"	No. 6 Coal	L	co		
1161-e	SW	SE	NW	16	4S	1E	<1	4	1	5	—	—	6"	No. 6 Coal	L	co		
1161-f	SW	SE	NW	16	4S	1E	1	3	1	4	—	—	6"	No. 6 Coal	L	co		
1161-g	SW	SE	NW	16	4S	1E	1	4	1	4	—	—	6"	No. 6 Coal	L	co		
1161-h	SW	SE	NW	16	4S	1E	1	3	1	4	—	—	6"	No. 6 Coal	L	co		
1161-i	SW	SE	NW	16	4S	1E	1	4	2	4	—	—	6"	No. 6 Coal	L	co		
1161-j	SW	SE	NW	16	4S	1E	1	4	1	4	—	—	6"	No. 6 Coal	L	co		
1161-k	SW	SE	NW	16	4S	1E	<1	4	1	5	—	—	6"	No. 6 Coal	L	co		
1161-l	SW	SE	NW	16	4S	1E	<1	4	1	5	—	—	6"	No. 6 Coal	L	co		
1229			NE	9	4S	1E	—	5	—	4	—	—		No. 5 Coal	N	mi		
1839	NE	SW	SE	3	4S	1E	1	4	—	5	—	—	24"+	No. 6 Coal	N	co		
1847				3	4S	1E	2	2	—	6	—	—	6"+	No. 6 Coal	N	co		
2097-a	SE	NE	NE	8	4S	1E	1	3	—	6	—	—		No. 6 Coal	O	co		
2294	SW	NE	NE	33	3S	2E	1	4	2	4	—	—	40"	No. 5 Coal	L	co		
2295	NW	NW	NW	20	3S	1E	<1	4	—	6	—	—	25"	No. 5 Coal	N	co		
JERSEY COUNTY																		
1110			SE	9	7N	10W	3	4	—	4	—	—		No. 4 Coal	I	oc		
2214		SW	NE	10	7N	10W	Tr	3	—	7	—	—	66"	No. 6 Coal	P	oc		
JOHNSON COUNTY																		
1807*	NW	SE	NE	8	11S	4E	1	5	2	3	—	—	30"	Bidwell Coal	K	oc		
1830	NE	SE	NE	8	11S	4E	4	3	—	3	—	—	8"+	New Burnside Coal	H	oc		
KANKAKEE COUNTY																		
1320-a		NE	SE	5	31N	9E	9	—	—	1	—	—		No. 2 Coal	A	mi		X
KNOX COUNTY																		
A-80				16	11N	2E	5	5	—	<1	—	—		No. 1 Coal	H	mi		
A-85				16	11N	2E	4	2	—	4	—	—		No. 1 Coal	H	mi		
1187		Cen.	SW	27	12N	3E	1	6	—	3	—	—		No. 6 Coal	M	oc		
1293		NW	NE	17	9N	4E	—	5	—	5	—	—		No. 5 Coal	O	oc		
1294-b		NW	NE	12	11N	3E	—	5	—	5	—	—		No. 5 Coal	N	oc		
1385	NE	NW	SW	6	9N	2E	2	4	2	2	—	—	24"+	No. 2 Coal	J	oc		X
1391	NW	SW	NW	13	10N	1E	1	4	2	2	—	—	36"+	No. 2 Coal	L	oc		X
1394-a	SE	cor.	NW	36	9N	1E	4	Tr	—	6	—	—	24"	No. 2 Coal	H	oc		X
1394-b	SE	cor.	NW	36	9N	1E	2	6	Tr	2	—	—	30"	Spoon Fm.	J	oc		X
1533*	SE	NW	SE	4	11N	2E	1	4	4	1	—	—	6"	No. 2 Coal	L	oc		

APPENDIX – Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
KNOX COUNTY (cont.)																	
1534*	NE	SW	SW	3	11N	2E	–	4	–	6	–	–	12"+	Abingdon Coal	P	oc	
1535*	NE	SW	SW	3	11N	2E	4	5	Tr	1	–	–	60"	Abingdon Coal	L	oc	
1536*	SE	SE	SW	28	10N	4E	–	6	–	4	–	–	24"+	Carbondale Fm.	O	oc	
1538*	SW	SW	NW	27	10N	2E	2	6	1	1	–	–	60"	No. 2 Coal	J	oc	
1539*	NW	NW	NW	33	10N	2E	4	6	Tr	<1	–	–	48"	No. 2 Coal	J	oc	
1540*	NE	NW	SW	10	9N	2E	4	4	–	2	–	–	60"	No. 2 Coal	H	oc	
1541*	NE	NE	NE	17	9N	2E	4	5	–	2	–	–	24"+	Spoon Fm.	I	oc	
1542*	SW	SW	SE	5	9N	2E	3	4	–	2	–	–	30"	No. 2 Coal	I	oc	
1543*	SW	NE	NE	8	9N	2E	3	5	–	2	–	–	48"	Spoon Fm.	I	oc	
1544*	SW	NE	NE	8	9N	2E	3	2	–	6	–	–	24"	Spoon Fm.	M	oc	
1545*	SW	NE	NE	8	9N	2E	3	5	Tr	2	–	–	48"	Greenbush Coal	J	oc	
1546*	SW	NE	NE	8	9N	2E	3	5	Tr	2	–	–	60"	No. 2 Coal	J	oc	
1548*	SW	SE	SW	18	10N	2E	1	6	2	1	–	–	60"	No. 2 Coal	K	oc	
1549*	Cen.	W½	SE	35	10N	1E	2	2	–	6	–	–	36"	No. 2 Coal	I	oc	
1550*	SE	NW	NW	32	10N	1E	2	3	–	5	–	–	24"+	No. 2 Coal	M	oc	
1551*	NE	NE	NW	31	10N	1E	3	5	Tr	2	–	–	66"	No. 2 Coal	J	oc	
1552*	SW	SE	NW	31	9N	2E	4	4	Tr	2	–	–	36"	No. 2 Coal	H	oc	
1553*	SW	SE	NW	36	9N	1E	5	4	Tr	1	–	–	30"	No. 2 Coal	H	oc	
1555*	SE	NE	SW	28	9N	2E	3	5	–	2	–	–	60"+	No. 2 Coal	I	oc	
1556*	NW	NE	NW	5	9N	2E	2	5	–	2	–	–	48"+	Spoon Fm.	I	oc	
1557*	SE	SE	NW	6	9N	2E	2	5	–	3	–	–	48"+	No. 2 Coal	I	oc	
1558*	Cen.	W½	NE	6	9N	2E	2	4	–	4	Tr	–	42"+	Abingdon Coal	I	oc	
1560*	NE	NE	NE	21	10N	3E	3	5	Tr	1	–	–	36"	No. 2 Coal	J	oc	
1561*	SE	NW	SW	13	10N	2E	3	7	–	<1	–	–	48"	No. 2 Coal	I	oc	
1562*	NE	SE	NW	14	10N	2E	2	6	2	<1	–	–	60"	No. 2 Coal	L	oc	
1563*	NE	NE	SE	26	10N	2E	3	5	–	2	–	–	36"+	Spoon Fm.	I	oc	
1564*		SW	NW	13	10N	1E	2	5	2	1	–	–	24"+	No. 2 Coal	L	oc	
1565*	NE	SE	NE	28	10N	3E	1	6	2	1	–	–	36"	No. 2 Coal	L	oc	
1566*	NE	SE	NE	28	10N	3E	2	6	2	Tr	–	–	54"	Spoon Fm.	L	oc	
1567*	NW	NE	NW	13	10N	2E	2	–	–	8	–	–	12"+	Spoon Fm.	O	oc	
1568*	SE	NE	NW	13	9N	2E	3	4	–	3	–	–	42"	No. 2 Coal	I	oc	
1569*	SW	NE	SW	13	9S	2E	3	5	–	2	–	–	66"	Abingdon Coal	I	oc	
1578*	SE	SE	SW	36	9N	1E	1	7	–	2	–	–	24"	Spoon Fm.	M	oc	
1579*	SE	SE	SW	36	9N	1E	3	7	Tr	<1	–	–	68"	Spoon Fm.	J	oc	
1580*	SE	SE	SW	36	9N	1E	2	3	–	5	–	–	50"	Spoon Fm.	I	oc	
1661			SE	35	9N	1E	1	5	–	5	–	–		No. 2 Coal	N	oc	
1842		NE	SW	26	9N	4E	2	8	Tr	Tr	–	–		No. 6 Coal	L	oc	
1844				22	12N	4E	2	5	2	2	–	–		No. 6 Coal	L	mi	
LA SALLE COUNTY																	
A–44				15	33N	1E	3	5	–	2	–	–		Lowell Coal	I	mi	
A–50				15	33N	1E	4	5	–	1	–	–		Lowell Coal	I	mi	
A–55				25	33N	4E	4	–	–	–	–	–		Lowell Coal	M	mi	
A–60				25	33N	4E	3	–	–	7	–	–		Lowell Coal	N	mi	
450–454		NW	SW	5	33N	4E	10	–	–	–	–	–	60"	No. 2 Coal	A	mi	
1101			NE	26	33N	3E	Tr	4	–	6	–	–	48"	No. 4 Coal	N	oc	
1102		SW	SW	5	31N	3E	1	5	Tr	4	–	–	32"	No. 4 Coal	M	oc	
1103			NE	31	34N	4E	Tr	5	1	4	–	–	72"	No. 4 Coal	L	oc	
1387	NE	NE	NE	19	33N	3E	7	2	–	1	–	–	14"	No. 2 Coal	F	oc	X
1388	NW	SE	NW	8	32N	2E	6	4	–	1	–	–	30"	No. 2 Coal	G	oc	X
1397	SW	SW	SW	9	33N	3E	9	<1	–	Tr	–	–	48"	No. 2 Coal	E	oc	X

APPENDIX – Continued

Sample	Location						Clay mineral composition† (parts in ten)						Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
	¼	¼	¼	Sec.	T.	R.	K	I	C	Mx	V	Mt					
LA SALLE COUNTY (cont.)																	
10		SW	SW	5	33N	4E	10	—	—	—	—	—		No. 2 Coal	A	oc	X
1485*	SW	NE	SW	8	32N	2E	7	3	—	1	—	—	17"	No. 2 Coal	G	oc	
1486–a*	NE	NW	SW	8	32N	2E	6	3	—	<1	—	—	84"	No. 2 Coal	G	oc	
1488*	NW	SE	NW	5	32N	2E	7	3	—	<1	—	—	204"	No. 2 Coal	F	oc	
1489	NE	NE	SW	29	33N	2E	8	1	—	1	—	—	96"	No. 2 Coal	E	oc	
1490*	NW	SW	NW	32	33N	2E	—	—	—	—	—	—	60"	No. 2 Coal	F	oc	
1491–a*	NE	NW	SE	21	33N	2E	7	—	—	3	—	—	35"	No. 2 Coal	B	oc	
1491–b*	NE	NW	SE	21	33N	2E	5	—	—	5	—	—	25"	Spoon Fm.	D	oc	
1492–a*	N½	N½	S½	21	33N	2E	5	—	—	5	—	—	96"	No. 2 Coal	C	oc	
1493*	NE	NE	SE	21	33N	2E	7	2	—	1	—	—	72"	No. 2 Coal	F	oc	
1494*	Cen.	NE	SW	22	33N	2E	3	2	—	5	—	—	72"	No. 2 Coal	H	oc	
1495*	NW	SE	SE	22	33N	2E	—	3	—	1	—	—	60"	No. 2 Coal	G	oc	
1496–a*	SE	NE	NE	27	33N	2E	5	—	—	5	—	—	24"	No. 2 Coal	D	oc	
1497*	SE	NE	NE	27	33N	2E	8	1	—	<1	—	—	108"	No. 2 Coal	B	oc	
1498*	NE	SE	NW	25	33N	2E	9	<1	—	<1	—	—	96"	No. 2 Coal	A	oc	
1499*	SW	NE	SE	25	33N	2E	7	—	—	3	—	—	48"	No. 2 Coal	C	oc	
1500*	NW	SE	NE	30	33N	3E	10	—	—	<1	—	—	72"	No. 2 Coal	A	oc	
1501	Cen.	SW	SW	11	33N	1E	6	—	—	4	—	—	84"	No. 7 Coal	F	mi	
1502*	SW	NW	NW	30	33N	3E	10	—	—	<1	—	—	60"	No. 2 Coal	A	oc	
1503*	Cen.	S½	NE	29	33N	3E	10	—	—	Tr	—	—	84"+	No. 2 Coal	A	oc	
1504*	Cen. E½		NE	SE	21	33N	3E	1	4	—	5	—	—	24"+	Lowell Coal	I	oc
1505*	NE	SW	NW	28	33N	3E	4	5	—	2	—	—	12"+	Lowell Coal	I	oc	
1506*	SW	NW	NW	22	33N	3E	9	2	—	<1	—	—	96"	No. 2 Coal	C	oc	
1507*	SE	NW	NW	6	34N	5E	4	5	—	2	—	—	18"	Lowell Coal	H	oc	
1508*		Cen.	E½	1	34N	4E	<1	7	—	3	—	—	10"	Spoon Fm.	I	oc	
1509*	SW	NW	SW	13	33N	2E	6	2	—	2	—	—	24"	No. 2 Coal	G	oc	
1510*	SW	NW	SE	13	33N	2E	7	2	—	1	—	—	14"	No. 2 Coal	F	oc	
1511*	NE	NW	SE	18	33N	3E	7	2	—	<1	—	—	30"	No. 2 Coal	F	oc	
1512*	NE	NE	NE	17	33N	3E	9	1	—	—	—	—	72"	No. 2 Coal	D	oc	
1513*	SW	SW	SE	18	33N	3E	10	<1	—	—	—	—	72"	No. 2 Coal	B	oc	
1514*	NE	NW	SW	9	33N	3E	9	1	—	<1	—	—	12"+	No. 2 Coal	B	oc	
1871			SW	5	32N	2E	1	6	2	Tr	—	—		Carbondale Fm.	L	oc	
2220	NE	SE	SE	9	31N	3E	3	4	Tr	3	—	—	60"+	No. 7 Coal	J	oc	
2240		NW	SE	10	30N	2E	—	4	1	6	—	—		No. 5 Coal	L	co	
2266		SE	SW	8	32N	2E	—	5	1	5	—	—	8"	No. 5 Coal	K	oc	
LIVINGSTON COUNTY																	
2241		SW	SW	21	28N	6E	1	2	2	5	—	—		No. 6 Coal	M	co	
2247		NE	SE	34	30N	3E	Tr	3	1	6	—	—		No. 5 Coal	L	co	
2249		SW	SW	21	28N	6E	Tr	6	2	2	—	—		No. 5 Coal	L	co	
2250			Cen.	9	27N	6E	1	4	—	5	—	—		No. 6 Coal	M	co	
2252		SW	SW	7	28N	6E	1	3	—	6	—	—	48"+	No. 6 Coal	N	co	
2255		SW	SW	21	28N	6E	1	4	1	4	—	—	36"	No. 7 Coal	L	co	
MC DONOUGH COUNTY																	
976–xx*	NW	SE	SW	11	5N	4W	2	5	Tr	3	—	—		No. 2 Coal	I	oc	X
1379	SE	SE	SW	11	5N	4W	6	4	—	<1	—	—	36"	No. 2 Coal	G	oc	X
1380	NE	NE	NE	12	5N	3W	5	4	—	1	—	—	18"	No. 2 Coal	H	oc	X
1529		N½	SW	12	5N	4W	5	3	—	2	—	—	80"	No. 2 Coal	G	oc	
1837	NE	NW	NW	26	6N	3W	7	2	—	1	—	—	12"+	Spoon Fm.	F	oc	
1838–a	SE	NE	NW	15	5N	4W	7	1	—	2	—	—	8"+	Spoon Fm.	E	oc	
1838–b	SE	NE	NW	15	5N	4W	6	2	—	2	—	—	12"	Spoon Fm.	F	oc	

APPENDIX — Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
MACOUPIN COUNTY																	
A-150				29	8N	6W	<1	2	—	6	—	2		No. 6 Coal	Q	mi	
A-158				29	8N	6W	1	2	—	5	—	2		No. 6 Coal	Q	mi	
A-166				10	7N	7W	3	2	—	5	—	—		No. 6 Coal	N	mi	
A-173				10	7N	7W	<1	3	Tr	7	—	—		No. 6 Coal	P	mi	
1180				9	12N	6W	2	6	Tr	2	—	—		No. 6 Coal	L	mi	
1181				9	12N	6W	1	4	—	5	—	—		No. 6 Coal	N	mi	
2239		NW	NE	35	8N	6W	5	2	—	3	—	—		No. 2 Coal	G	co	
2300	SE	SE	NE	8	12N	5W	1	3	—	6	—	—		No. 6 Coal	N	co	
MADISON COUNTY																	
A-182				34	4N	8W	Tr	2	—	6	—	2		No. 6 Coal	Q	mi	
960-c*	SE	NW	NW	15	5N	9W	9	—	—	1	—	—	18"	No. 2 Coal	C	oc	X
960-d*	SE	NW	NW	15	5N	9W	8	1	—	<1	—	—	18"	No. 2 Coal	D	oc	X
1138				29	6N	5W	5	2	—	3	—	—		No. 6 Coal	G	mi	
2052	NE	SW	NE	12	6N	9W	<1	4	—	6	—	—	28"+	No. 6 Coal	P	co	
2053	NE	SW	NE	12	6N	9W	7	1	—	2	—	—	32"+	No. 2 Coal	C	co	
2222	SW	SE	SW	22	6N	5W	1	5	1	2	—	—	18"+	No. 6 Coal	L	co	
2238		NE	NW	18	3N	7W	—	3	—	7	—	—		No. 6 Coal	P	co	
MARION COUNTY																	
2022	NW	NE	NE	31	2N	1E	4	2	—	5	—	—		No. 6 Coal	M	mi	
MARSHALL COUNTY																	
1386	NW	SE	NW	23	12N	9E	3	3	—	4	—	—	36"	No. 7 Coal	I	oc	X
1649		NE	NW	26	12N	9E	1	6	3	<1	—	—		No. 2 Coal	K	co	
1773		NE	NW	26	12N	9E	1	5	3	2	—	—	24"+	No. 2 Coal	K	co	
1774		NE	NW	26	12N	9E	2	5	2	1	—	—	6"+	Abingdon Coal	K	co	
1775		NE	NW	26	12N	9E	2	5	2	1	—	—	6"+	Greenbush Coal	K	co	
1776		NE	NW	26	12N	9E	4	5	—	1	—	—	12"+	Wiley Coal	H	co	
1777		NE	NW	26	12N	9E	8	2	—	1	—	—	12"+	Coal below Seahorne Ls.	D	co	
1778		NE	NW	26	12N	9E	3	4	—	3	—	—	48"+	DeLong Coal	I	co	
1780		NE	NW	26	12N	9E	2	7	—	1	—	—	12"+	Tarter Coal	I	co	
2244		NE	NW	26	12N	9E	—	4	<1	5	—	—		No. 5 Coal	L	co	
MENARD COUNTY																	
466				26	19N	5W	<1	3	—	7	—	—		No. 5 Coal	O	mi	
467				26	19N	5W	—	3	—	7	—	—		No. 5 Coal	P	mi	
468				26	19N	5W	—	4	—	6	—	—		No. 5 Coal	O	mi	
469				26	19N	5W	—	3	—	7	—	—		No. 5 Coal	P	mi	
470				26	19N	5W	—	3	—	7	—	—		No. 5 Coal	O	mi	
MERCER COUNTY																	
1393-a	NW	SW	NW	8	14N	2W	1	3	1	5	—	—	7"	No. 2 Coal	K	oc	X
1393-b	NW	SW	NW	8	14N	2W	2	5	3	<1	—	—	8"	No. 2 Coal	K	oc	X
1395	SE	NW	SW	33	14N	2W	9	1	—	<1	—	—	30"	Abbott Fm.	C	oc	X
1581*	SW	NW	SW	33	14N	2W	8	1	—	<1	—	—	36"	No. 2 Coal	E	oc	
1706*	SE	NE	NW	32	14N	2W	4	2	—	4	—	—	24"	No. 1 Coal	H	oc	
1707*	NW	SW	SE	5	14N	2W	3	5	—	2	—	—	48"+	No. 1 Coal	H	oc	
1710*	SE	NW	SE	33	14N	2W	7	2	—	1	Tr	—	60"	No. 1 Coal	E	oc	
1711*	SW	SE	NW	1	13N	2W	9	—	—	2	—	—	24"+	No. 2 Coal	D	oc	
1712*	NE	NE	NE	5	13N	2W	6	3	—	1	Tr	—	36"	Abbott Fm. (upper)	F	oc	
1713*	SE	NW	SW	33	15N	3W	9	Tr	—	<1	Tr	—	36"	Hermon Coal	A	oc	

APPENDIX — Continued

Sample	Location						Clay mineral composition† (parts in ten)						Thickness of underclay	Associated stratigraphic position of underclay	Type	Source††	Particle size†††
	¼	¼	¼	Sec.	T.	R.	K	I	C	Mx	V	Mt					
MERCER COUNTY (cont.)																	
1714*	NE	NW	SE	35	15N	3W	5	3	—	2	—	—	42"	Hermon Coal	G	oc	
1715*	NE	NW	SE	35	15N	3W	7	3	—	<1	Tr	—	54"	Hermon Coal	F	oc	
1716*	NE	NW	SE	35	15N	3W	7	2	—	1	—	—	48"	Hermon Coal	F	oc	
1717*	SW	NW	SW	32	14N	2W	5	4	—	2	—	—	132"	Spoon Fm. (lower)	F	oc	
1718*				26	14N	1W	2	5	—	3	—	—	42"	No. 1 Coal	I	mi	
MONROE COUNTY																	
1796*	NE	NW	NE	3	2S	10W	<1	3	Tr	7	—	—	36"	No. 6 Coal	Q	oc	
1797*	SW	NE	NW	15	2S	10W	1	5	—	4	—	—	60"+	No. 6 Coal	P	oc	
MONTGOMERY COUNTY																	
1178	NE	NE	NW	27	12N	5W	4	3	Tr	3	—	—		No. 6 Coal	L	co	
1184				13	8N	4W	2	3	—	4	—	—		No. 6 Coal	N	mi	
1438	SW	SW	NW	33	9N	2W	<1	8	Tr	2	—	—		No. 2 Coal	M	co	X
1849	SE	SW	SW	6	7N	4W	1	3	—	5	—	—		No. 6 Coal	P	co	
1850	NE	SE	SE	8	8N	4W	3	4	—	3	—	—		No. 6 Coal	M	co	
1851	NE	NW	SW	23	7N	3W	1	4	—	5	—	—		No. 6 Coal	O	co	
1852	NW	NW	SE	16	7N	3W	Tr	3	—	6	—	2		No. 6 Coal	Q	co	
1853	SE	NE	SW	18	7N	2W	2	4	—	4	—	—		Carbondale Fm.	N		
1854	SE	SE	SW	20	7N	2W	4	3	—	3	—	—		No. 6 Coal	M	co	
1879	NE	SE	SE	31	9N	4W	2	3	—	6	—	—		No. 6 Coal	N	co	
1882-d	SE	SW	SW	28	9N	4W	2	3	—	5	—	—		No. 6 Coal	N	co	
1888	SW	NE	NW	12	7N	4W	4	3	—	3	—	—	12"+	No. 4 Coal	H	co	
1890	NE	NW	SE	18	8N	4W	4	3	Tr	3	—	—		No. 6 Coal	M	co	
2028	SE	SW	SW	6	7N	4W	1	2	—	7	—	—		No. 6 Coal	N	co	
2030	SW	SE	SE	20	9N	4W	2	4	Tr	4	—	—	48"	No. 6 Coal	M	co	
2031	NW	NW	NW	27	9N	4W	3	4	—	4	—	—	24"+	No. 6 Coal	M	co	
2032	NW	NW	SW	3	7N	4W	<1	3	—	7	—	—	24"+	No. 6 Coal	O	co	
2033	NE	NW	NE	15	7N	4W	Tr	2	—	8	—	—	36"+	No. 6 Coal	P	co	
2034	SW	SW	SE	17	8N	4W	4	3	—	3	—	—		No. 6 Coal	M	co	
2035	SW	SW	NE	14	7N	5W	1	4	—	5	—	—	24"+	No. 6 Coal	N	co	
2036	SW	SW	NE	14	7N	4W	Tr	2	—	6	—	2	24"+	No. 6 Coal	Q	co	
2037	SE	SE	SW	2	7N	4W	Tr	2	—	5	—	3	24"+	No. 6 Coal	Q	co	
2093	NW	NE	NE	20	7N	4W	1	2	<1	6	—	—		No. 6 Coal	N	co	
2094	SE	NW	NE	16	7N	4W	3	4	2	1	—	—	66"	No. 6 Coal	L	co	
2286	NE	NW	NW	14	7N	3W	5	1	—	4	—	—		No. 4 Coal	G	co	
2287	SW	SE	NW	33	9N	2W	6	<1	—	4	—	—		No. 4 Coal	G	co	
MORGAN COUNTY																	
1225			NE	33	13N	8W	—	6	—	4	—	—		No. 8 Coal	O	oc	
2215	NE	SE	NE	30	13N	10W	Tr	5	—	5	—	—	60"	No. 6 Coal	O	oc	
MOULTRIE COUNTY																	
1152		SE	Cor.	12	15N	6E	2	3	—	6	—	—		No. 6 Coal	N	mi	
PEORIA COUNTY																	
A-94				8	7N	7E	—	5	—	5	—	—		No. 5 Coal	O	mi	
1188	SE	NE	NE	20	11N	5E	1	4	—	6	—	—		No. 6 Coal	N	mi	
1188-p	SE	NE	NE	20	11N	5E	1	3	2	4	—	—		No. 6 Coal	N	mi	
A-100				8	7N	7E	2	6	2	Tr	—	—		No. 5 Coal	L	mi	
1189	Cen. S line NE			30	9N	7E	—	6	1	3	—	—		No. 6 Coal	L	mi	
1965	SE	NW	SE	1	8N	6E	—	5	—	5	—	—	24"	No. 8 Coal	O	oc	
1966	NW	SE	SW	3	8N	5E	—	5	Tr	6	—	—	12"+	No. 8 Coal	O	oc	

APPENDIX – Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
PEORIA COUNTY (cont.)																	
1991			SE	32	7N	6E	4	3	Tr	3	—	—	36"+	No. 2 Coal	J	mi	
2219		NE	SE	16	11N	5E	4	5	—	2	—	—	36"	No. 6 Coal	M	mi	
2224				33	24N	6W	4	4	—	3	—	—		No. 2 Coal	I	mi	
2225		NW	NE	2	8N	6E	2	6	Tr	3	—	—		No. 6 Coal	L	oc	
2227		NE	SE	26	7N	6E	1	5	Tr	4	—	—		No. 6 Coal	L	oc	
2229		NE	SE	26	7N	6E	1	6	—	4	—	—		No. 5 Coal	N	oc	
PERRY COUNTY																	
A-210				36	5S	3W	Tr	2	—	7	—	—		No. 6 Coal	P	mi	
A-221				36	5S	3W	—	5	—	6	—	—		No. 6 Coal	O	mi	
1133			NW	30	6S	1W	7	1	—	2	—	—		?	F	oc	
1173				26	5S	2W	2	1	—	7	—	—		No. 6 Coal	N	oc	
1177	NE	NW	NW	31	5S	4W	Tr	1	—	8	—	—		No. 6 Coal	P	mi	
1309-a		SW	NE	5	6S	1W	5	4	Tr	2	—	—	6"	No. 2 Coal	H	co	X
1309-b		SW	NW	5	6S	1W	6	3	—	2	—	—	12"	No. 2 Coal	H	co	X
1309-c		SW	NW	5	6S	1W	8	—	—	2	—	—	54"	No. 2 Coal	D	co	X
1782	NW	SW	NW	5	6S	1W	5	2	—	3	—	—		No. 6 Coal	N	co	
1783	NW	SW	NW	5	6S	1W	2	6	Tr	2	—	—	12"	No. 4 Coal	N	co	
1784	NW	SW	NW	5	6S	1W	5	2	—	2	—	—	12"	No. 2 Coal	H	co	
1786	NW	SW	NW	5	6S	1W	6	3	—	1	—	—		Spoon Fm.	H	co	
PIKE COUNTY																	
996-M	NE	NE	SE	4	4S	5W	7	2	—	1	—	—	60"	No. 2 Coal	D	oc	X
1381	NE	SE		4	4S	5W	8	—	—	2	—	—	36"+	No. 2 Coal	D	oc	X
1382-a	NW	NW	NE	10	4S	5W	8	—	—	2	Tr	—	25"	No. 2 Coal	D	oc	X
1723		NW	NW	6	5S	4W	9	—	—	1	—	—	11"+	No. 2 Coal	B	oc	
1924		SE	NW	11	4S	4W	9	—	—	1	—	—	36"	No. 2 Coal	B	oc	
1925			S½	25	4S	5W	9	—	—	1	—	—	36"+	No. 2 Coal	B	oc	
2071	SE	SE	SE	28	5S	4W	9	—	—	1	Tr	—	48"+	No. 2 Coal	B	oc	
POPE COUNTY																	
1836	NE	SW	SE	31	11S	5E	1	7	Tr	3	—	—	40"	Gentry Coal?	J		
RANDOLPH COUNTY																	
R-11		SW	SW	26	5S	6W	<1	4	2	4	—	—		No. 5 Coal	L	oc	
1174	SE	NE	NE	21	5S	5W	—	5	—	5	—	—		No. 6 Coal	P	mi	
1430	SW	NE	SW	28	4S	5W	—	5	Tr	5	—	—		No. 2 Coal	P	co	X
1874				35	5S	5W	—	3	—	7	—	—		No. 6 Coal	P	mi	
NF208	SE	SW	NE	25	5S	5W	3	3	—	4	—	—		Carbondale Fm.	J	oc	
ROCK ISLAND COUNTY																	
1390	SE	NE	SW	5	16N	3W	5	5	Tr	<1	—	—	30"+	Spoon Fm.	H	oc	X
1593*	NE	NE	SW	28	17N	1W	6	4	—	Tr	—	—	30"	No. 1 Coal	G	oc	
1594*	SW	SE	NW	31	17N	1W	2	7	3	Tr	—	—	20"+	Caseyville Fm.	L	oc	
1595*	NE	NE	SE	14	17N	2W	4	6	Tr	—	—	—	30"	Caseyville Fm.	I	oc	
1596*	Cen.	N½	SE	25	17N	1W	5	3	—	1	—	—	60"	Spoon Fm. (lower)	F	oc	
1597*	Cen.	S½	NE	25	17N	1W	6	3	—	2	—	—	84"	No. 1 Coal	G	oc	
1598*	Cen.	S½	NE	25	17N	1W	6	4	Tr	<1	—	—	24"+	Hermon Coal	G	oc	
1599*	SE	NE	SE	5	17N	1E	2	5	2	1	—	—	120"	Spoon Fm. (lower)	K	oc	
1600*	SE	NE	SE	5	17N	1E	8	2	Tr	<1	—	—	0-10'	Spoon Fm. (lower)	F	oc	
1601*	Cen.	E½	NW NW	4	17N	1E	7	2	—	1	—	—	24"	Spoon Fm. (lower)	F	oc	

APPENDIX — Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
ROCK ISLAND COUNTY (cont.)																	
1602*	SW	NW	SW	8	17N	1E	7	3	—	<1	—	—	24"+	Spoon Fm. (lower)	F	oc	
1603*	SE	NW	NW	9	17N	1E	5	4	—	2	—	—	24"+	Spoon Fm. (lower)	H	oc	
1604*	SE	NW	NW	9	17N	1E	5	3	—	1	Tr	—	18"+	Spoon Fm. (lower)	G	oc	
1605*	NW	NW	SW	9	17N	1E	5	3	—	2	—	—	72"	Spoon Fm. (lower)	H	oc	
1606*	NW	NW	SE	26	17N	4W	5	3	—	2	—	—	36"	Caseyville Fm.	G	oc	
1607*	NW	NW	SE	26	17N	4W	8	2	—	<1	—	—	31"	Caseyville Fm.	E	oc	
1608*	NE	SE	SW	35	17N	4W	6	2	—	2	—	—	42"	Abbott Fm.	F	oc	
1609*	NE	SE	SW	35	17N	4W	6	1	—	4	Tr	—	132"	Abbott Fm.	F	oc	
1610*	NW	NW	NE	34	17N	1W	5	3	—	2	—	—	18"	Spoon Fm.	H	oc	
1612*	SE	SE	SW	32	17N	1W	8	2	—	1	—	—	24"+	Abbott Fm.	F	oc	
1613*	NE	NE	SE	11	17N	1W	7	2	—	2	—	—	40"	Spoon Fm.	F	oc	
1614*	SE	NE	SW	29	17N	3W	3	5	Tr	2	Tr	—	45"	Spoon Fm. (middle)	J	oc	
1615*	NW	NE	SE	21	16N	4W	6	3	—	1	—	—	50"	Abbott Fm.	G	oc	
1616*	NW	SW	NW	27	16N	5W	7	2	—	1	—	—	156"	Caseyville Fm.	F	oc	
1617*	SE	SE	SW	30	17N	3W	5	3	Tr	2	—	—	12"+	Abbott Fm. (lower)	H	oc	
1618*	NE	NW	NE	36	17N	4W	8	1	—	<1	—	—	44"+	Spoon Fm. (lower)	C	oc	
1619*	SE	NE	SE	36	17N	4W	4	Tr	—	6	—	—	43"	Coal below Seahorne Ls.	I	oc	
1620*	SE	NE	SE	36	17N	4W	6	3	—	1	—	—	36"+	DeLong Coal	G	oc	
1621*	NW	SW	SW	30	17N	3W	4	5	—	2	—	—	36"	Abbott Fm.	I	oc	
1622*	SW	SW	SW	30	17N	3W	5	3	—	3	—	—	32"	Abbott Fm.	H	oc	
1623*	NE	NE	NE	35	17N	4W	5	4	—	1	—	—	46"	Abbott Fm.	H	oc	
1624*	NW	SE	SE	29	17N	3W	7	2	—	1	—	—	48"	Abbott Fm. (middle)	F	oc	
1625*	NE	NW	SW	4	16N	3W	2	4	Tr	5	—	—	31"	Spoon Fm. (middle)	M	oc	
1626*	NE	NW	SW	4	16N	3W	3	5	—	3	—	—	24"	Spoon Fm. (middle)	M	oc	
1627*	NW	SE	SE	32	17N	3W	6	3	—	1	—	—	24"+	Abbott Fm. (middle)	G	oc	
1628*	SE	NW	SE	32	17N	3W	5	4	—	1	—	—	44"	Abbott Fm. (middle)	H	oc	
1629*	NE	SW	NW	9	17N	1E	6	3	—	<1	—	—	42"	Spoon Fm. (lower)	F	oc	
1630*	SE	SE	NW	32	17N	3W	5	5	—	<1	—	—	50"	Spoon Fm. (lower)	H	oc	
1631*	SE	SE	NW	32	17N	3W	5	4	Tr	1	—	—	91"	Spoon Fm. (lower)	G	oc	
1632*	NE	NE	SW	25	17N	4W	3	3	—	3	—	—	36"	Abbott Fm. (middle)	I	oc	
1633*	SW	NW	NE	5	16N	3W	2	4	—	3	—	—	38"	Spoon Fm. (middle)	I	oc	
1634*	NE	SE	NE	31	17N	3W	5	3	—	2	—	—	90"	Spoon Fm. (lower)	H	oc	
1635*	NW	SE	NE	31	17N	3W	7	3	—	<1	—	—	48"	Abbott Fm. (upper)	F	oc	
1669*	SE	NW	NW	25	17N	4W	5	3	—	2	—	—	18"	Abbott Fm. (middle)	G	oc	
1670*	NE	SW	SW	25	17N	4W	4	4	Tr	2	—	—	36"+	Abbott Fm. (upper)	H	oc	

APPENDIX — Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle‡‡ size
ROCK ISLAND COUNTY (cont.)																	
1671*	NE	NE	SE	2	16N	5W	7	2	—	<1	Tr	—	36"+	Abbott Fm.	F	oc	
1672*	NW	NW	SE	2	16N	5W	5	3	Tr	2	—	—	42-48"	Abbott Fm.	H	oc	
1673*	SW	SE	NE	2	16N	5W	3	5	—	2	—	—	48"+	Abbott Fm. (lower)	I	oc	
1674*	SW	SE	NE	3	16N	5W	4	5	—	1	—	—	12-66"	Caseyville Fm.	I	oc	
1675*	NW	NW	NW	11	16N	5W	4	4	Tr	2	—	—	42"+	Abbott Fm. (upper)	H	oc	
1679*	SW	NE	SW	6	16N	4W	7	2	—	1	Tr	—	60"	Abbott Fm. (upper)	F	oc	
1680*	SW	SW	NE	6	16N	4W	6	3	—	1	Tr	—	36"+	Abbott Fm. (upper)	G	oc	
1681*	NW	SE	NW	11	16N	5W	5	4	—	1	Tr	—	72"	Abbott Fm.	H	oc	
1682*	NE	SE	NW	11	16N	5W	7	2	—	1	Tr	—	36"+	Abbott Fm.	F	oc	
1684*	SE	NE	SW	28	17N	3W	5	4	Tr	1	—	—	60"+	Caseyville Fm.	H	oc	
1685*	SE	NE	SW	1	16N	5W	5	4	—	1	Tr	—	36"	Abbott Fm.	H	oc	
1686*	SW	NE	NE	6	16N	4W	2	6	Tr	2	Tr	—	36"	Abbott Fm.	L	oc	
1687*	SW	NE	NE	6	16N	4W	3	5	Tr	3	Tr	—	24"+	Abbott Fm.	K	oc	
1688*	NW	NW	NW	8	16N	4W	7	2	—	2	Tr	—	46"	Spoon Fm.	F	oc	
1689*	NW	NW	NW	8	16N	4W	6	3	—	2	—	—	30"	Spoon Fm.	G	oc	
1708*	NW	SE	SW	32	17N	4W	4	5	—	1	Tr	—	18"+	Abbott Fm.	H	oc	
1709*	NE	NE	SW	28	17N	3W	2	6	—	2	—	—	18"+	Caseyville Fm.	I	oc	
1721	SW	SE	NE	36	17N	4W	2	5	2	1	—	—	10"	Caseyville Fm.	L	oc	
2096		SW	SE	31	18N	2E	Tr	3	—	7	—	—	30"+	Caseyville Fm.	P	oc	
ST. CLAIR COUNTY																	
A-192				33	2N	8W	<1	3	—	7	—	—		No. 6 Coal	P	mi	
A-200				33	2N	8W	Tr	3	—	4	Tr	4		No. 6 Coal	Q	mi	
1136		SW	NW	2	3S	7W	2	3	—	6	—	—		No. 6 Coal	P	mi	
1137			Cen.	31	1N	8W	<1	3	—	8	—	—		No. 6 Coal	P	mi	
1153				31	2N	7W	2	3	—	6	—	—		No. 6 Coal	P	mi	
1175			Cen.	31	1N	8W	Tr	1	—	9	—	—		No. 6 Coal	P	mi	
1176	SW	NW	SE	12	3S	7W	—	2	—	8	—	—		No. 6 Coal	Q	mi	
1372		SE	SE	9	1N	9W	9	—	—	1	Tr	—		No. 2 Coal	B	oc	X
1377-a	NW	NW	SW	34	1N	9W	9	—	—	2	—	—	30"	No. 2 Coal	B	oc	X
1377-b	NW	NW	SW	34	1N	9W	9	—	—	2	—	—	33"	No. 2 Coal	B	oc	X
1384	SE	NW	SE	24	1N	9W	9	—	—	1	—	—	36"	No. 2 Coal	B	co	X
1719*	NW	NW	NW	34	1N	9W	9	—	—	2	Tr	—	36"	No. 2 Coal	B	oc	
1730				6	1S	8W	—	2	—	8	—	—		No. 6 Coal	Q	mi	
1875		SW	SE	27	2S	7W	<1	4	—	6	—	—		No. 6 Coal	P	mi	
1895	SW	NE	NW	28	2N	7W	1	2	—	6	—	—	13"+	No. 6 Coal	P	co	
1897	NW	SE	NE	33	2N	7W	1	3	Tr	7	—	—	26"+	No. 6 Coal	N	co	
1898	SE	NE	NE	32	2N	7W	<1	3	—	7	—	—	12"+	No. 6 Coal	N	co	
1899	SW	SE	SW	29	2N	7W	1	3	—	6	—	—		No. 6 Coal	P	co	
2188			Cen.	31	1N	8W	—	2	—	8	—	—		No. 6 Coal	Q	mi	
SALINE COUNTY																	
A-309				24	8S	6E	1	5	2	2	—	—		No. 5 Coal	L	mi	
A-318				24	8S	6E	2	5	2	1	—	—		No. 5 Coal	L	mi	
A-320				2	9S	6E	3	5	Tr	2	—	—		No. 6 Coal	L	mi	
A-325				2	9S	6E	1-2	6	2	<1	—	—		No. 6 Coal	L	mi	
A-342				20	10S	5E	6	Tr	—	4	—	—		Davis Coal	F	mi	
1101-a	SE	SE	SE	24	9S	5E	1	3	1	4	—	—		No. 5 Coal	L	mi	
1101-i	SE	SE	NW	18	9S	6E	1	5	2	3	—	—		No. 5 Coal	L	mi	

APPENDIX — Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
SALINE COUNTY (cont.)																	
1101-k	SW	SE	SE	24	9S	5E	1	5	2	2	—	—		No. 5 Coal	L	mi	
1148		SW	SW	9	9S	5E	3	3	4	—	—	—		No. 6 Coal	N	mi	
1165	NE	SE	SE	22	9S	7E	1	4	—	5	—	—		No. 5 Coal	N	mi	
1166		NW	Cor.	8	9S	5E	<1	4	—	5	—	—		No. 6 Coal	N	mi	
1167	SE	Cor.	SE	6	9S	5E	1	4	—	5	—	—		No. 6 Coal	N	co	
1168	SE	SE	SE	6	9S	5E	<1	4	—	5	—	—		No. 6 Coal	N	co	
1300	NW	SE	NW	14	8S	6E	2	5	Tr	3	—	—		No. 6 Coal	N	co	
1435			N½	23-24 line	10S	5E	3	5	Tr	1	—	—		No. 2 Coal	J	oc	
1794	NW	SW	NW	16	10S	6E	8	—	—	2	—	—	30"	No. 2 ? Coal	B		
1804*	NW	NE	NW	26	10S	7E	4	4	—	3	—	—	60"	No. 2 Coal	H	mi	
1805*	SW	SW	SE	23	9S	7E	1	5	—	4	—	—	36"	Dekoven Coal		mi	
1808*	NE	NW	NW	25	10S	7E	2	3	Tr	6	—	—	42"+	Spoon Fm.	J	oc	
1811*			Cen.	4	10S	7E	5	4	—	1	—	—	28"	Dekoven Coal	G	mi	
1812*			Cen.	4	10S	7E	4	4	—	2	—	—		Davis Coal	H	mi	
1813*	SE	NE	SW	5	10S	7E	6	1	—	3	—	—	72"	No. 2 Coal	D	mi	
1814*	NW	SE	SW	21	10S	6E	8	—	—	2	—	—	36"	Mt. Rorah Coal	B	oc	
1815*	NW	SW	SE	20	10S	6E	2	5	—	3	—	—	36"	Spoon Fm.	I	oc	
1816*	SW	NE	NW	21	10S	5E	4	4	—	2	—	—	42"	No. 2 Coal	H	mi	
1817*	SW	NE	NE	21	10S	5E	4	5	—	1	—	—	34"	Dekoven Coal	H	mi	
1818*	SW	NE	SE	25	10S	7E	6	3	—	1	—	—	36"	Spoon Fm.	F	oc	
1819*	SW	NE	SE	25	10S	4E	1	4	—	5	—	—	66"	Spoon Fm.	N	oc	
1820*	SW	NE	SE	25	10S	4E	1	5	—	4	—	—	48"	Spoon Fm.	N	oc	
1821*	NE	SE	NE	23	10S	5E	2	3	—	4	—	—	96"	Spoon Fm.	I	oc	
1826	NW	NE	NW	26	10S	7E	4	4	—	2	—	—	12"+	Dekoven Coal	H	mi	
1833	NW	NW	NE	1	10S	7E	3	5	Tr	3	—	—	18"	No. 5 Coal	J	oc	
1834	NE	SE	NE	24	10S	7E	2	5	Tr	3	—	—		No. 5 Coal	J	mi	
1835		S½	NW	16	10S	6E	7	3	—	Tr	—	—	18"	Dekoven Coal	F	mi	
1848	W½	SW	NW	16	10S	6E	5	4	—	2	—	—		No. 2 Coal	H	co	
2023	SW	SE	SE	4	10S	7E	4	4	—	2	—	—	18"	Spoon Fm.	H	co	
2051		NE	SW	4	10S	5E	4	3	Tr	3	—	—	102"	No. 2 Coal	K	co	
2285			NW	1	8S	7E	Tr	5	1	4	—	—		No. 4 Coal	L	co	
SANGAMON COUNTY																	
A-139	NW	NW	SW	27	17N	5W	Tr	7	—	3	—	—		No. 5 Coal	O	mi	
A-146	NW	NW	SW	27	17N	5W	2	5	1	3	—	—		No. 5 Coal	O	mi	
1896	NW	NW	NW	33	13N	4W	3	4	—	4	—	—		No. 6 Coal	L	co	
2098	SW	SW	SW	19	13N	4W	1	4	—	5	—	—	1"?	No. 6 Coal	M	co	
2099		NW	NW	18	13N	4W	Tr	3	—	7	—	—	1"?	No. 6 Coal	P	co	
2257		NW	SW	8	13N	4W	2	5	1	3	—	—	24"	No. 6 Coal	L	co	
2258		NW	SW	5	13N	4W	Tr	1	—	9	—	—	7"	No. 6 Coal	Q	co	
2259		SW	SE	26	14N	5W	Tr	3	—	7	—	—	21"	No. 6 Coal	Q	co	
2260		NW	SW	22	14N	5W	Tr	3	—	7	—	—	17"	No. 6 Coal	Q	co	
2261		NE	NE	20	14N	5W	—	3	—	7	—	—	18"	No. 6 Coal	Q	co	
2262		Cen.	N½	30	14N	5W	—	4	—	6	—	—	16"	No. 6 Coal	P	co	
2263		NE	NE	30	14N	4W	Tr	6	—	4	—	—	10"	No. 6 Coal	M	co	
2264		SW	SW	20	14N	5W	3	3	—	4	—	—	14"	No. 6 Coal	M	co	
2265		SW	SW	18	14N	4W	2	3	1	4	—	—	12"	No. 6 Coal	M	co	
2283	NW	NW	SW	15	13N	5W	1	3	2	4	—	—	38"	No. 4 Coal	L	co	
2284	NE	NE	SW	17	13N	5W	3	3	—	4	—	—	30"	No. 4 Coal	M	co	

APPENDIX — Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
SCHUYLER COUNTY																	
978-kkk*	NW	NW	NE	23	3N	3W	5	5	Tr	<1	—	—	60"+	No. 2 Coal	J	oc	X
978-ooo				31-36 line	2N	1W	2	6	3	<1	—	—	42"	No. 2 Coal	K	oc	X
1288-a		NE	NW	26	2N	1W	—	3	Tr	7	—	—		No. 5 Coal	N	oc	
1288-b		NE	NW	26	2N	1W	<1	2	1	6	—	—		No. 5 Coal	L	oc	
1374-a	SE	NE	NE	33	2N	2W	2	5	2	2	—	—	34"	No. 2 Coal	K	oc	X
1374-b	SE	NE	NE	33	2N	2W	2	5	2	2	—	—	33"+	No. 2 Coal	K	oc	X
2226	NW	NW	NW	26	2N	1W	1	6	Tr	3	—	—	36"	No. 6 Coal	L	oc	
SCOTT COUNTY																	
1772		NW	NW	14	13N	12W	9	1	—	<1	—	—		No. 2 Coal	B	oc	
SHELBY COUNTY																	
2230		NW	SE	8	11N	4E	2	5	2	2	—	—	72"+	Shelbyville Coal	K	oc	
STARK COUNTY																	
1841		SW	NW	13	13N	6E	1	3	2	4	—	—		No. 6 Coal	N	mi	
TAZEWELL COUNTY																	
A-103				18	25N	4W	—	3	—	7	—	—		No. 5 Coal	O	mi	
A-108				18	25N	4W	—	4	—	6	—	—		No. 5 Coal	O	mi	
2223			Cen.	19	25N	4W	7	2	—	2	—	—		No. 2 Coal	G	oc	
2246		SE	NE	6	24N	4W	1	2	1	6	—	—	60"	No. 6 Coal	L	co	
2251		SE	NE	6	24N	4W	4	2	—	4	—	—		No. 4 Coal	I	co	
2253		SE	NE	6	24N	4W	3	4	Tr	4	—	—	8"	No. 2 Coal	J	co	
VERMILION COUNTY																	
A-18				19	18N	11W	2	6	2	Tr	—	—		No. 6 Coal	K	mi	
1132				2	19N	12W	2	6	Tr	3	—	—	12"+	No. 7 Coal	I	mi	
1154		SE	SE	6	19N	11W	1	4	—	5	—	—		No. 6 Coal	N	oc	
1793				3	19N	12W	4	6	Tr	2	—	—		No. 7 Coal	I	mi	
1877*	NW	NW	SW	25	19N	12W	6	—	—	4	—	—	120"	No. 8 Coal	D		
1969	SW	NE	SW	14	18N	11W	1	2	—	7	—	—	36"	No. 6 Coal	N	oc	
1970	SE	SE	NW	27	19N	11W	3	2	—	5	—	—	36"	Modesto Fm.	N	oc	
1971				27	19N	11W	1	4	—	4	—	—	10"	No. 6 Coal	N	oc	
1973	SW	SW	NW	27	19N	11W	4	2	—	4	—	—	36"	No. 6 Coal	N	oc	
1974	SW	SW	SE	12	19N	12W	<1	3	1	5	—	—	72"	Modesto Fm.	L	oc	
1975	SW	SW	NE	12	19N	12W	3	4	Tr	3	—	—	21"	No. 7 Coal	I	oc	
1976	SE	SE	SW	12	19N	12W	2	8	Tr	<1	—	—	32"	Modesto Fm.	L	oc	
1977	SE	SE	SW	12	19N	12W	3	2	—	5	—	—	53"	No. 6 Coal	N	oc	
1978	SE	SE	SW	12	19N	12W	2	1	—	7	—	—	31"	Modesto Fm.	N	oc	
1979	NW	NW	SW	32	19N	13W	<1	3	—	7	—	—	30"	Modesto Fm.	N	oc	
1980	SW	SE	NE	22	19N	13W	1	1	—	8	—	—	12"	Modesto Fm.	P	oc	
1983	SW	SE	NE	7	19N	11W	1	4	—	5	—	—	10"	Modesto Fm.	N	oc	
1984	SW	SE	NE	7	19N	11W	3	3	—	4	—	—	10"	Modesto Fm.	N	oc	
1988	NE	NW	SW	14	18N	11W	3	3	—	4	—	—	6-36"	No. 6 Coal	N	oc	
2040*	NE	SE	SE	23	19N	13W	4	—	—	6	—	—	108"	Modesto Fm.	N	oc	
WARREN COUNTY																	
977-v				24	8N	1W	6	3	—	1	—	—	24"	No. 2 Coal	C	oc	X
WASHINGTON COUNTY																	
2237		NW	NW	33	3S	2W	<1	5	1	3	—	—		No. 5 Coal	L	co	

APPENDIX — Continued

Sample	Location ¼	¼	¼	Sec.	T.	R.	Clay mineral composition† (parts in ten) K	I	C	Mx	V	Mt	Thickness of underclay	Associated stratigraphic position of underclay	Type	Source‡	Particle size‡‡
WHITE COUNTY																	
2245		NE	NW	18	7S	10E	2	5	Tr	3	—	—		No. 5 Coal	L	co	
WHITESIDE COUNTY																	
NF411			NW	3	22N	4E	9	—	—	1	—	—	24"	Abbott Fm.	B	oc	
WILL COUNTY																	
A-28				33	33N	9E	5	3	Tr	2	—	—		No. 2 Coal	K	mi	
A-35			NE	32	33N	9E	5	4	Tr	1	—	—		No. 2 Coal	K	mi	
A-39			NE	32	33N	9E	4	4	Tr	2	—	—		No. 2 Coal	K	mi	
NF-398	SE	SE	SE	4	32N	9E	4	4	Tr	2	—	—	18"	No. 2 Coal	K		
1893	150'	NNE	Cen.	NE	32N	9E	8	1	—	1	Tr	—		No. 2 Coal	B	co	
WILLIAMSON COUNTY																	
A-283				11	8S	2E	2	5	2	2	—	—		No. 6 Coal	L	mi	
A-289				11	8S	2E	<1	5	Tr	5	—	—		No. 6 Coal	N	mi	
A-296				16	9S	4E	1	6	—	3	—	—		No. 6 Coal	N	mi	
A-304				16	9S	4E	2	4	—	4	—	—		No. 6 Coal	N	mi	
1105	NE	NE	NW	12	8S	3E	1	4	—	5	—	—		No. 4 Coal	M	co	
1303-a	SE	NE	SE	7	9S	4E	1	5	2	3	—	—		No. 5A Coal	L	co	
1303-c	SE	NE	SE	7	9S	4E	<1	3	Tr	7	—	—		No. 6 Coal	N	co	
1304-c	NW	NE	NE	17	8S	3E	1	5	—	4	—	—		DeGraff Coal	I		
1311-d	SE	SW	NE	21	8S	3E	2	4	Tr	5	—	—	22"	DeGraff Coal	I	co	
1373		SE	SE	22	9S	2E	4	5	—	1	—	—	72"	No. 2 Coal	M	oc	X
1376	SW	SW	NE	4	10S	4E	<1	9	—	1	—	—	24"	No. 2 Coal	N	oc	X
1802*	SW	NE	SE	25	10S	3E	6	Tr	—	4	—	—	60"	Mt. Rorah Coal	D	oc	
1803*	NW	SW	NW	22	10S	4E	1	4	—	5	—	—	36"	Spoon Fm.	N	oc	
1825	NW	SW	NW	22	10S	4E	Tr	4	—	6	—	—	48"	Spoon Fm.	N	oc	
1829			SE	15	10S	4E	1	5	1	3	—	—	60"	Dekoven Coal	K	mi	
2282	NE	NE	NW	12	8S	3E	<1	4	<1	5	—	—		No. 4 Coal	L	co	
WOODFORD COUNTY																	
A-115				6	28N	2E	1	5	2	2	—	—		No. 2 Coal	L	mi	
A-120				6	28N	2E	1	6	2	1	Tr	—		No. 2 Coal	L	mi	

* = Ceramic data in other Illinois State Geological Survey publications or on open file.

† = Under "Clay mineral composition": K = kaolinite, I = illite, C = chlorite, Mx = mixed-structure clay minerals, V = vermiculite, Mt = montmorillonite, Tr = trace.

‡ = Under "Source": oc = outcrop, mi = mine, co = core.

‡‡ = Under "Particle size": X = data available in tables 1, 2, and 3.

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